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FACTORS INFLUENCING ORGANIZATIONAL ACCEPTANCE OF TECHNOLOGICAL CHANGE IN TRAINING

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In the interviews, very different points of view were expressed by members of the researcher, funder, developer, and user communities. Each community appeared governed by its own perspective, while holding attitudes toward the other communities ranging from sympathetic to antagonistic. It was hypothesized that many problems of innovation acceptance are caused by the present limited interactions and feedback loops among these communities.

The model which was developed has been found useful in structuring thinking about problems of innovation acceptance. It was hypothesized that it will be useful in identifying organizational processes that might benefit from change, and identifying areas where future research on the acceptance process may have the greatest impact.

FACTORS INFLUENCING ORGANIZATIONAL ACCEPTANCE
OF TECHNOLOGICAL CHANGE IN TRAINING

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Many people in many Navy organizations gave generously of their time to help us meet the objectives of this project. Whether they represented the offices of the Undersecretary of the Navy, the Chief of Naval Operations, the Chief of Navy Material, the Systems Commands, the Chief of Naval Education and Training, the Fleet Training Commands, or the everyday users of training devices, they were uniformly interested in this study and desirous of organizational changes that might lead to improved training technology and to the design of training devices that are uniformly high in user acceptance. Their viewpoints often differed strongly concerning what is presently right and wrong with the training device acquisition process, but they were always offered sincerely.

We particularly wish to recognize the many contributions of Dr. Arthur Blaiwes of the Naval Training Equipment Center who worked with us throughout the project. He gave us the benefit of his ideas, arranged for us to interview key members of the NAVTRAEEQUIPCEN staff, secured relevant documentation for us, and made important contributions to many of our interview sessions. He also provided us with a critical review of this document.

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SECTION ONE

INTRODUCTION

THE PROBLEM

The costs associated with the operation of major Navy systems make increased dependence on simulators and other types of training devices for achieving and maintaining operational readiness an economic imperative. This is particularly true in the area of flight training, although it can be said of other major systems as well. For example, in a document issued by the Chief of Naval Operations, cited by Stoffer, Blaiwes, and Brichtson (1980), a plan was formulated for achieving a 25 percent reduction in Navy flight hours, and consequent fuel savings, by the end of 1981. The flight simulator is seen, by some higher command echelons in the Navy, as the potential vehicle for flight substitution in achieving and maintaining necessary operational skills. Traditionally, however, local training commands have viewed the simulator as a means for supplementing rather than replacing aircraft training. According to Stoffer, et al., (1980) (citing Navy Audit Review 24) this type of discrepancy in the perceived proper role of flight simulators is a major reason for documented underutilization of aviation training devices and the consequent failure to demonstrate cost savings through flight hour reductions.

If training devices are to assume increasing roles as substitutes for the use of operational equipment in meeting training objectives, it is clear that

they must be accepted by Navy personnel in that role. This is a particularly complex issue when the training device is used for refresher training or advanced skill development as opposed to initial skills training. Mackie, Kelley, Moe, and Mecherikoff (1972), in an earlier study of factors influencing the acceptance and use of Navy training devices, observed that the level of user experience in the area of operations represented by a trainer was often a major factor influencing acceptance. In general, if the trainer was seen as having simulation deficiencies, experienced personnel were more critical of it than were less experienced personnel. However, inexperienced personnel depreciated the value of a trainer because, in their view, its use conflicted with the opportunity to "do the real thing."

It is evident from the work of Mackie, et al., (1972) and from a more recent investigation by Caro, Shelnutt, and Spears of the utilization of Air Force aircrew training devices (1980) that training device acceptance is a function of a multiplicity of factors, some having to do with the fidelity of simulation of the equipment and operating environment, some having to do with design factors that facilitate or impede the instructional process, some having to do with the quality of instructor personnel and their attitudes toward the usefulness of training devices, some having to do with the perceived role of the training device within the framework of a broader training program, some having to do with trainer reliability, and some having to do with organizational attitudes and procedures, both local and at higher echelons in the command structure. Deficiencies in any of these areas can lead to under-utilization, inappropriate utilization, or outright rejection of training devices (Mackie, 1975).

Caro, et al., (1980) cited several studies which indicate that aircrew training devices (ATDs) are used more effectively when there is a dominant positive attitude toward their use in training, whereas negative attitudes prevail in units where ATDs are less effectively used. The question of whether the attitude precedes the pattern of use or follows it may be moot, but the association is sufficiently strong that an understanding of the variables affecting attitude formation in the context of trainer use would seem essential to the Navy's interests. Stoffer, et al., (1980) have emphasized that increased acceptance of ATDs is especially critical at this time because:

1. Significant advances in effective training technology remain to be incorporated into the Fleet, some of which may involve problems of innovation acceptance.
2. A variety of low cost, low fidelity approaches to training system design are under development which may encounter user resistance because of the traditional emphasis on high physical fidelity.
3. There is increasing need to introduce training improvements and have them accepted as early as possible, to avoid the steadily increasing delay time in making needed training capabilities available in conjunction with the delivery of major weapon systems.
4. Training technology will be increasingly integrated into Fleet operational systems. With the advent of compact portable equipment that can be used aboard ship, as well as training devices imbedded in actual operational equipment, special problems of acceptance and use may be anticipated.
5. A substantial reduction in the number of hours available for using actual operational equipment for training purposes is likely, if not certain.
6. Operational tasks continue to increase in complexity, and the consequences of human error or deficient performance are increasingly costly.

TOWARD A SOLUTION

The purpose of this study was to develop increased understanding of the individual, group, organizational, and hardware factors that determine the acceptance and optimal utilization of innovations in training technology. It is evident that the Navy will undergo a period of increased dependence in the 1980's on various types of innovative training devices. Many of these devices, especially those involving new technology and, in some cases, low physical fidelity, will likely pose problems of innovation acceptance on the part of both individuals and Navy organizations.

A product of the study was a predictive model of the process of acceptance (or rejection) of training devices which reflects some of the theoretical constructs of organizational change and the psychology of innovation acceptance. An objective of the project was the operationalization of those constructs in terms of variables found to operate at all levels in the Navy that impact the acceptance and use of training devices in their intended roles. We viewed the study as a problem in organizational psychology because, although actual training device usage is undoubtedly influenced by many design and pedagogical factors, organizational change is necessary at several levels in the Navy if the broadened role of training devices in achieving operational readiness is to be realized.

Mackie (1975) has pointed out that no trainer is totally "accepted" or "unaccepted." However, there is little doubt that the acceptance of training devices can be increased with the consequence of both improved training and

greater cost-effectiveness. The problem is how to accomplish this objective in a systemic manner that is also cost-effective. To date, there has been no systematic approach or plan for insuring user acceptance (Stoffer, et al., 1980). The result is that neither the developers nor the users of trainers know how to handle acceptance problems when they occur. Further, there is no basis, at this time, for predicting the impact of particular training device features that will serve to enhance or degrade user acceptance other than the general dictum that acceptance can be "bought" through a high degree of physical fidelity, an approach that may not enhance training but will certainly prove costly.

In an effort to move toward a solution to these problems, research was conducted to develop a model of factors influencing user acceptance based on (1) results of studies previously conducted specifically on the trainer acceptance issue; (2) data from comprehensive interviews with various "players" in the innovation and acceptance process; and (3) previous theoretical modeling of organizational change and innovation acceptance. The next section describes useful concepts from a review of the literature on innovation acceptance, technology transfer, and organizational development. Section 3 provides an overview of the Navy's training device acquisition processes, Section 4 presents the model which was developed, and Section 5 provides an interpretation of interview results in the context of the model. The text is supported by detailed material presented in the Appendices.

SECTION TWO

REVIEW OF THE LITERATURE

INNOVATION ACCEPTANCE

In general, the acceptance of new training devices and new training technology was viewed as a special case of the general problem of innovation acceptance. Indeed, the problems associated with low cost, "low fidelity"¹ trainers would appear to pose a particular challenge to the application of innovation acceptance theory.

The innovation-decision process has been described in the literature as the mental process through which an individual passes, starting with his first knowledge of an innovation, to an eventual decision to adopt or reject (Rogers and Shoemaker, 1971). The stages in this process have been described by many researchers and include (1) awareness (first knowledge of the innovation), (2) interest (gaining further knowledge about it), (3) evaluation (gaining a favorable or unfavorable attitude toward the innovation), (4) small scale trial, and (5) decision to adopt or reject. Rogers and Shoemaker call the final stage "confirmation," feeling that this allows for post-decision communication behavior which usually reinforces the original decision but may lead to its reversal.

¹Fidelity in this context refers to the degree of physical and functional resemblance between the trainer and the operational system. High fidelity may be neither necessary nor sufficient for effective training of particular tasks.

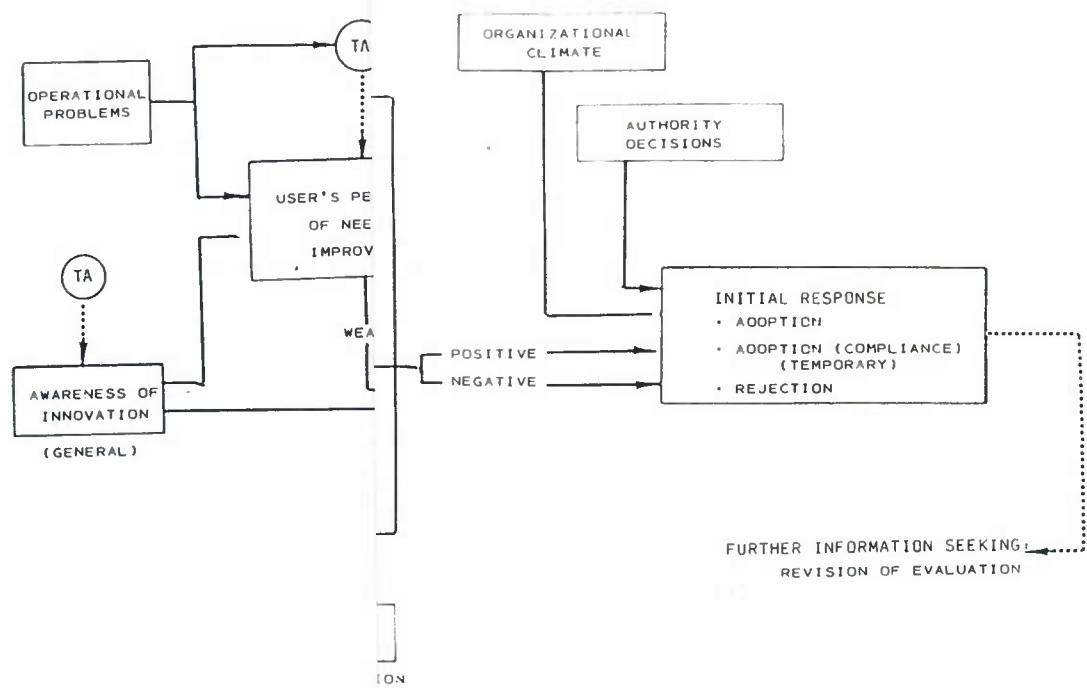


Figure 1 diagrams the dynamics of the innovation-decision process as we hypothesize it might occur during the introduction of new training technology. We will elaborate on this diagram in some detail.

Initial Awareness

Initial awareness of a new device or training technique is stimulated in Navy personnel through a variety of channels, both formal and informal. It is important to recognize that if the training system is truly innovative, i.e., it is not simply an improved version of an older system, the content of this initial communication can be very important to acceptance. There is an important distinction in this regard between personnel who may be in their initial stages of training and who have no prior experience with training devices, and those who are undergoing refresher training or advanced tactical training. The latter personnel may have a far different perspective, as previously noted, about the role that training devices should play in the total training program than the former.

Whatever the nature of the initial communication, it is important that it be accurate and reasonably comprehensive. In military organizations, remarkable word of mouth inaccuracies can pervade initial awareness. Obviously, any such distortions can adversely impact the acceptance process.

In the diagram, we have shown a "trainer advocate" (TA) making an input to initial awareness. The TA is modeled after the "change advocate," a professional who, in various ways, influences innovation decisions by means of direct interactions with user personnel. Though the change advocate has had a

long and historically important role in promoting the adoption of innovations in other contexts, he is rarely if ever evident during the process of introducing new systems to military organizations. (For this reason, dashed lines are used to show the areas of his impact in the figure). Nevertheless, earlier studies (Mecherikoff and Mackie, 1970; Mackie, 1975; Caro, et al., 1980) have emphasized the importance of the advocacy role. It is notable that both Navy and Air Force studies, conducted independently, identified of informal advocacy by a few highly motivated individuals, with very desirable trainer acceptance and use outcomes. Usually this has occurred without official direction by local commands.

Immediate Perception of Need

Whatever the source of the initial communication, the user's immediate perception of the need for a training innovation will be a function of the problems he has experienced in the operational arena. It is, unfortunately, a simplification to assume that all potential users will have the same appreciation of the operational problem. There is also a risk that some users will view the development agency as not fully perceptive of the operational problem and that this will be reflected in trainer design deficiencies. It is also likely, of course, that different categories of users (e.g., undergraduate pilots versus experienced ones) will have quite different perceptions of the need.

One of the complicating factors in the introduction of many innovations is that the intended users may not be particularly aware of the need that stimulated its development. This problem is frequently encountered as a

consequence of high turnover rates among military personnel. During the time required for trainer development, the perception of need may change considerably, either because of individual differences in perspective or because of actual changes in operational requirements. This is perhaps less of a problem in the case of system simulators because of their clear relationship to their operational counterparts. Nevertheless, there are two major roles for the trainer advocate at this stage: (1) He can be the source of valid information concerning current and future operational problems associated with the new trainer development and (2) He can be the source of valid information concerning how the innovation is expected to aid in solving those problems.

Level Of Interest

Initial level of interest is clearly a function of the user's perception of need for improvement and a general awareness of the purpose of the training innovation. If he personally identifies with the operational problems the trainer is designed to address, or if the trainer advocate has done his job in making him aware of those problems, his initial level of interest should be high enough that he will at least be receptive to further information about the innovation, even if, at this stage, he does not actively seek it. On the other hand, if his perception of the need for improvement is low, no further information seeking or reception may occur.

Information Acquisition

Assuming some degree of information seeking or, at least receptivity, information received through personal communication channels is likely to be more persuasive at this early stage than that received through other media (Rogers and Shoemaker, 1971). The important point to consider is that, in the absence of authoritative messages, the user's² general perception of the innovative system can be a function of informal channels that may contain a good deal of "noise." Indeed, there is no assurance that authoritative information will be provided at this stage in the absence of controlled presentations by the development agency or a trainer advocate. Further, it should be recognized that, in the absence of authoritative sources, the information void will be filled through informal channels. The likelihood that certain misconceptions will develop through these channels seems particularly high when the innovative system is viewed as intrusive on other, more established training procedures.

²The term "user" is employed here in a broad sense. It refers not only to students who will utilize the trainer but to instructor personnel who may be assigned to operate it, as well as to administrative personnel and those further up in the training command and/or Fleet hierarchy with responsibilities for training and readiness.

Perceived Features and Perceived Need

Whatever its sources, the initial information is responsible for the user's early perception of the potential usefulness of the new development to him. There follows a general more or less favorable impression depending on how congruent this perception is with the user's view of the operational problem and felt need for improvement. This initial reaction may be based on more or less detail concerning various features of the innovation and, indeed, congruence may increase or decrease as further information is acquired. As indicated in the Figure 1 the process is viewed as interactive; subsequently received information can result in either increasing or decreasing the match between perceived need and various perceived features of the innovation.

Subjective Evaluation

As Stoffer, et.al., (1980, op.cit.) have noted, the criteria of acceptance at the user level are based on a tradition which requires the user to make primarily subjective determinations of training value. In their view, as well as ours, subjective opinion will continue to be a primary determiner of innovation acceptance. Although they note that subjective acceptance of training equipment does not guarantee optimal training value, it is nonetheless true that the absence of a positive subjective evaluation will limit effective use of the trainer regardless of its theoretical advantages. Because of the central role of subjective evaluation in the acceptance process, several postulated aspects of the process, as shown in Figure 1, will be briefly described.

Relative Advantage is defined as the degree to which an innovation is perceived as better than the idea or device it is intended to supercede. The relative advantage of an innovation, as viewed by members of the user group, is positively related to its rate of adoption (Rogers and Shoemaker, 1971)

It probably follows that any innovation that is not seen as having relative advantage has little prospect of adoption in the Navy. However, even when there is evidence of relative advantage, adoption is not insured because many other practical considerations enter into the acceptance-rejection decision. The identification of these considerations, some of which are discussed later, should be one of the main concerns during the process of introducing innovations.

Compatibility is defined by theorists as the degree to which an innovation is perceived to be consistent with the existing values, past experience, and needs of the users. In addition, Navy personnel are concerned with compatibility in the sense that an innovation must be operationally compatible with other systems with which it must work. (This point is germane to the concept of embedded trainers or on-board trainers of any type.) Innovation-acceptance theory suggests that the compatibility of an innovation, as perceived by its users, is positively related to its rate of adoption (Rogers and Shoemaker, 1971).

Complexity is defined as the degree to which an innovation is perceived as relatively difficult to understand and use. The complexity of an innovation, as perceived by users of the system, is generally regarded as negatively

related to its rate of adoption (Rogers and Shoemaker, 1971). However, there are some subtleties involved. An innovative system may experience rejection if it is seen as oversimplifying a problem that is known to be inherently complex (Mackie, 1980).

Observability is the degree to which the results of the use of an innovation are visible to others. The observability of an innovation, as perceived by the users of the system, is considered to be positively related to its rate of adoption (Rogers and Shoemaker, 1971). A demonstration of positive results is likely to be particularly important in stimulating acceptance of innovative devices about which there is initial skepticism.

Trialability is the degree to which an innovation may be experimented with by user personnel on a limited basis. The trialability of an innovation, as perceived by users of the system, is considered to be positively related to its rate of adoption. It should be noted that actual trial may occur, as in a demonstration, or it may be vicarious; that is, the user may simply visualize how the innovation might be used in his own operating environment, by himself or others.

It is evident that the first three aspects of subjective evaluation, outlined above, pertain primarily to the design of the innovation and the latter two relate to how it is introduced and/or demonstrated. The importance of the system advocate in providing information and demonstrations cannot be overestimated for new systems where user personnel will have an option as to whether or not to adopt. There is an important distinction in this respect between new systems that must be used (sensor systems, weapon systems,

navigation systems, etc.), because they are essential to mission accomplishment, and systems such as trainers whose use may, rightly or wrongly, be regarded as optional by the intended users.

Thus far we have discussed the inputs to subjective evaluations that reflect users' perceptions of various features of the innovation itself, augmented or not by actual observations and trial. There are, however, a number of other very important external influences on subjective evaluation which are quite apart from the innovative device itself.

Experience With Similar Developments

The intended user may have had experience with prior developments that he feels, correctly or not, are similar to the proposed innovation. If so, his subjective evaluation of the new training development may be biased, positively or negatively, depending on whether the prior experience was favorable or not. If there have been prior negative experiences, an important requirement of the introduction process is to counter the feeling that the new development will not be any better than the last. An innovation advocate can play a critical role in this regard, and he should be well aware of the deficiencies of earlier systems that are viewed as belonging to the same general category as the new one. It seems likely that this can be a particularly important function in promoting devices such as flight trainers since ATDs in general are likely to have gained a reputation among operational personnel concerning their capabilities and limitations in meeting various perceived training needs. The studies of both Mackie, et al. (1972) and Caro, et al, (1980) clearly indicate that either positive or negative

predispositions may be brought to a new training system depending upon a variety of experiential factors associated with earlier flight trainers.

A related consideration has to do with the technical reputation of the developer of the innovative system. (It should be noted that the developer, from the user's perspective, may be the project office, a Navy laboratory if one is involved, the Naval Training Equipment Center (NAVTRAEEQIPCEN), or the actual manufacturer of the equipment.) If the developer is viewed as having a history of product development that is not well matched to operational needs, a negative predisposition is likely. The opposite effect can also occur, if, of course, the reputation of the developer is generally favorable.

Competing Alternatives

It is rare that innovative developments are free from competition from alternative ways of doing things. Except in the case of a totally new system development, the "old way" of doing things is almost always an alternative that enters into the subjective assessment of relative advantage. In the case of ATDs, there is a special source of competition, namely, flight experience in the aircraft itself which, on the basis of anecdotal reports, can be expected to be a strong biasing factor in the subjective evaluation process. Stoffer, et al., (1980), in their analysis of user acceptance of R&D in Navy training, listed several sources of competing alternatives associated not only with individual users, but with groups and organizations that may affect the subjective evaluation:

1. Individual knowledge of an alternative training method
2. Individual attitudinal commitment to the alternative
3. Individual behavioral commitment to the alternative
4. Group behavioral commitment to the procedures called for by the alternative
5. Organization/institutional policy commitment to the alternative

It is important to recognize that the subjective evaluation may depend on perceived relative advantage of an alternative training approach or system whether or not that advantage is real in terms of its impact on operational readiness. The acceptance advantage usually enjoyed by training systems that have a high degree of physical resemblance to operational equipment provides an example. If a low cost, low fidelity simulator is capable of achieving specified training objectives as well or better than more elaborate and more costly systems, such systems are nevertheless likely to be viewed with an initial outset with a negative bias by users who have been brought up in the tradition of high fidelity simulation. The burden in such cases will fall much more heavily on observation and trial to demonstrate the relative advantage of low fidelity systems in regard to particular training objectives.

User Participation in Design

A strong, though sometimes temporary, negative bias toward innovative systems is reflected by the "not invented here" syndrome. This reaction is particularly likely if the innovative system is seen as an intrusion into the user's own area of technical expertise, which in the case of experienced

operational personnel, is very likely. If neither the user nor other personnel with similar qualifications were consulted with respect to design, an initial negative attitude toward the innovation is frequently the result. As noted in other studies of innovation acceptance in the Navy, highly qualified users should be involved in the design process if at all possible (Mecherikoff and Mackie, 1970). If they are not, the change advocate may have to make an effort to secure the endorsements of a recognized group of qualified peers. Caro, et al., (1980), cite examples of user confidence in new ATDs in cases where personnel from their units had been involved in the design process. Further, they cite a long-term positive subjective evaluation, over a period of several years, in the case of a device whose design was known to have been based, in part, on inputs from some of the unit's best pilots. In other cases, where ATDs were built and "dumped over the fence at night," the current users felt isolation from the development process and felt that the trainer had been designed by an anonymous "they" who "didn't know what we needed."

Stoffer, et al., (1980), reported that there has been little systematic application of this form of participative management in the entire process of trainer acquisition, effectiveness evaluations, and training optimization studies³. They cite as reasons (1) lack of the recognition of the value of participative management as a tool for gaining acceptance of change; (2) lack

³We will see later, however, that the Navy has made a concerted effort to deal with this need through the creation of Fleet Project Teams. Many variables operate to determine the actual role and effectiveness of these teams (See Section 3).

of operational definitions as to how participative management should be implemented; and (3) lack of formal documentation of successful applications of participative management to specific military training organizations. In spite of this, they report there is considerable empirical support for the value of participative management as a tool for introducing organizational change. Mecherikoff and Mackie (1970) support this view and cite an actual case of training device acceptance which was facilitated by user participation in design even though the "designing" occurred after the training device was actually built.

Personal Risk

All innovations carry some degree of subjective risk to the potential user. In the case of complex trainers, there are at least two categories of users to be considered: (1) the trainee himself and (2) the instructor. The instructor is likely to be uncertain, initially, as to how the innovation will affect the conduct of his assigned responsibilities. Since the instructor's acceptance of any innovative training equipment or technology is probably a necessary but not sufficient condition for student pilot acceptance, the manner in which perceived threats to his established expertise are handled becomes a critical element of the innovation introduction process.

Insofar as students are concerned, the degree of subjective risk can depend heavily on instructor protocol in using the training device. Caro, et al., comment on the importance of realism in training syllabi and scenarios and on the negative effect created by some instructors who insert unrealistic events or systems failures at a rate that make it impossible to perform well.

Thus, for the students, use of the trainer becomes a source of embarrassment. Faced with such situations, even when the value of properly conducted ATD training was clearly recognized, students soon developed apathetic and hostile attitudes toward trainer use because they were frustrated by their failures (Caro, et al, 1980). On a related point, Mackie, et al., (1972) found that users cited instructor qualifications as a major factor in the use and acceptance of a variety of Navy trainers.

Availability of Support

It is obvious that any new Navy system requires proper documentation, maintenance support, and, in the case of training devices, courseware. The significance of these factors, which we have simply labeled "support," lies in the early formation of attitudes of acceptance or rejection based on the user's prior experience with the adequacy of these support functions. Mackie, et al., (1972) found that lack of adequate support was a significant factor in the nonacceptance of some Navy training systems. At the time of their study, however, maintenance problems were probably more severe than they are today. Caro, et al., (1980) suggest that trainer reliability has increased markedly in recent years, but interviews conducted during this study (see Section 5) indicate that it is still a major problem with some trainers, and markedly affects user acceptance.

Support in the form of well designed courseware, however, is another matter. We have already commented on the use of scenarios by some instructors that student personnel feel represent unreasonable, non-operationally realistic demands. Unfortunately, with many trainers there is no carefully

designed courseware at all and much that is introduced in the way of training scenarios is at the whim of the instructor. Further, as Mackie, et al. (1972) found, it is often left up to fleet users to specify their own training scenarios. The latter approach assumes that the users know what type of scenario is most appropriate for meeting particular training objectives, an assumption that is doubtful at best. It is not suggested that the fleet user is unable to identify his operational problem, but rather that the translation of that problem into appropriate training scenarios is not an easy process for personnel who are not training specialists.

In the long run, after the system is actually implemented, continuing support is absolutely essential to avoid temporary adoption followed by subsequent disuse and rejection. It is an unfortunate commentary that some innovative Navy systems have fallen into disuse because of lack of adequate support despite the fact that they were developed to meet widely recognized needs.

In addition to "support" as defined here, an innovative training system may also require conceptual reinforcement on a periodic basis. The Navy system of personnel rotation, and relatively short tours of duty, fosters an unfortunate kind of "corporate memory loss" concerning the reasons why particular innovations were adopted in the first place. In the case of complex training devices, a consequence of this may be a progressive deterioration in the level of sophistication with which the training device is used. Mackie, et al.,(1972) found that many trainers designed to meet very complex training requirements were actually used in a way that relegated them to a "procedural" trainer, where the training objectives actually being served

could have been met with far less elaborate and less costly devices. Some of the intended, more sophisticated uses had simply dropped out of the program.

Organizational Climate

It is has long been held by various investigators that some organizations, more than others, provide a receptive climate for the introduction and acceptance of innovations. In the Navy, it seems very likely that individual commanding officers vary widely in their receptiveness of innovations, and, in cases where the adoption of a new system may be regarded as discretionary, this will strongly influence acceptance and use at the unit level.

The term climate has been defined as a set of properties of the work environment that is assumed to be a major force in influencing the behavior of the personnel in the system. These properties include such variables as organization size, structure, leadership pattern, interpersonal relationships, systems complexity, goal direction, and communication patterns (Hamner and Organ, 1978, p. 279). Citing Shein (1970), Hamner and Organ report that a "healthy" organizational climate is one that:

1. Takes in and communicates information reliably and validly;
2. Has the internal flexibility and creativity necessary to make the changes which are demanded by the information obtained;
3. Includes integration and commitment to the goals of the organization, from which comes the willingness to change;
4. Provides internal support and freedom from threat, since being threatened undermines good communication, reduces flexibility, and stimulates self protection rather than concern for the total system.

How the use and acceptance of training innovations might be affected by these and other variables associated with Navy organizations at the unit level and throughout higher echelons in the training command is by no means certain. Although anecdotal reports suggest that individual commanding officers vary widely in their receptivity to innovations, we know of no objective data to support this likely contention.

There are other variables apparently related to the "climate of receptiveness" which includes such factors as group cohesiveness, or the degree to which members of the group mutually influence one another; group norms, which serve to control the behavior of individual group members; "group think," a characteristic of close knit groups that has been described as decreasing the openness of the group members to critical examination of information which may sometimes be unsettling; and the various behaviors of group leaders (including informal ones) that may influence receptivity to new procedures and technology.

In the Figure 1, we have shown organizational climate as external to the subjective evaluation process. We believe this is appropriate because we perceive organizational climate as a thresholding influence which may affect the initial response of an individual toward adoption or rejection of an innovative system regardless of his subjective evaluation. For example, if his subjective evaluation is positive, but only mildly so, his perception of an organizational climate that is highly receptive might lead to an initial response to adopt. The same evaluation in a nonreceptive organizational climate might lead to an initial response to reject.

Authority Decisions

The remaining element of Figure 1 reflects the fact that decisions to adopt or reject are often made, particularly in the military, by authority. Authority innovation-decisions are those forced upon an individual by someone in a superordinate position of power. In effect, the individual is ordered to adopt or reject the new development (Rogers and Shoemaker, 1971). Obviously, in a military organization, authority innovation decisions are commonplace. However, no matter what the source of the decision, the users inevitably evaluate the innovation in terms of their own personal operational needs. This is not to say that they will not comply with the order. The authority decision will be accepted on the surface. However, compliance is a very different outcome from adoption. In the case of compliance, the change in behavior is often temporary, and continued surveillance and reinforcement are required to avoid gradual disuse and rejection. Thus, in the final box in Figure 1, we have distinguished between an initial response to adopt on the basis of subjective evaluation versus the temporary adoption that may occur in response to authority.

A final comment about this preliminary conceptualization is in order. It will be noted that the process ends with an initial propensity for adoption or rejection. Of course, in the early stage of the introduction of an innovation, this initial response may be followed by further information seeking, revision of the evaluation in accordance with new evidence, further consideration of competing alternatives, etc. Other models of the change process emphasize that acceptance of an innovation is eventually reflected in

organizational or institutional policy, i.e., that the change is institutionalized. While we have no fundamental disagreement with this view, and in fact have seen such institutionalization at times, it is worth noting that some innovations, as we previously pointed out, require continuing reinforcement due to the corporate memory loss associated with the high turnover rate of personnel in key positions, including those in training.

TECHNOLOGY TRANSFER

A second body of literature having pertinence to our project objectives was that dealing with the methodology of technology transfer. The Navy has sponsored technology transfer methodology and effectiveness measurement studies at the Naval Postgraduate School since 1969. More than 30 studies have been performed (Rohoer and Buckles, 1980). Of particular interest was a model of the technology transfer process originally presented in Creighton, Jolly and Denning (1972). A representation of this model is shown in Figure 2. The following brief explanations of the model factors viewed as influencing the transfer of knowledge from supplier to receiver, are excerpted from Jolly (1980).

1. Method of Information Documentation. This refers to the format, the language, the report complexity, and the documentation system.
2. The Distribution System. The distribution system has many forms. The primary distribution system is person to person; however, consideration needs to be given to journals, direct mail, meetings, conferences, and workshops. These are all effective methods and need to be selected and adjusted to provide an effective system in order to accomplish the specific objective of the organization.
3. The Formal Organization of the User. A comfortable organizational climate is often a climate of stability.

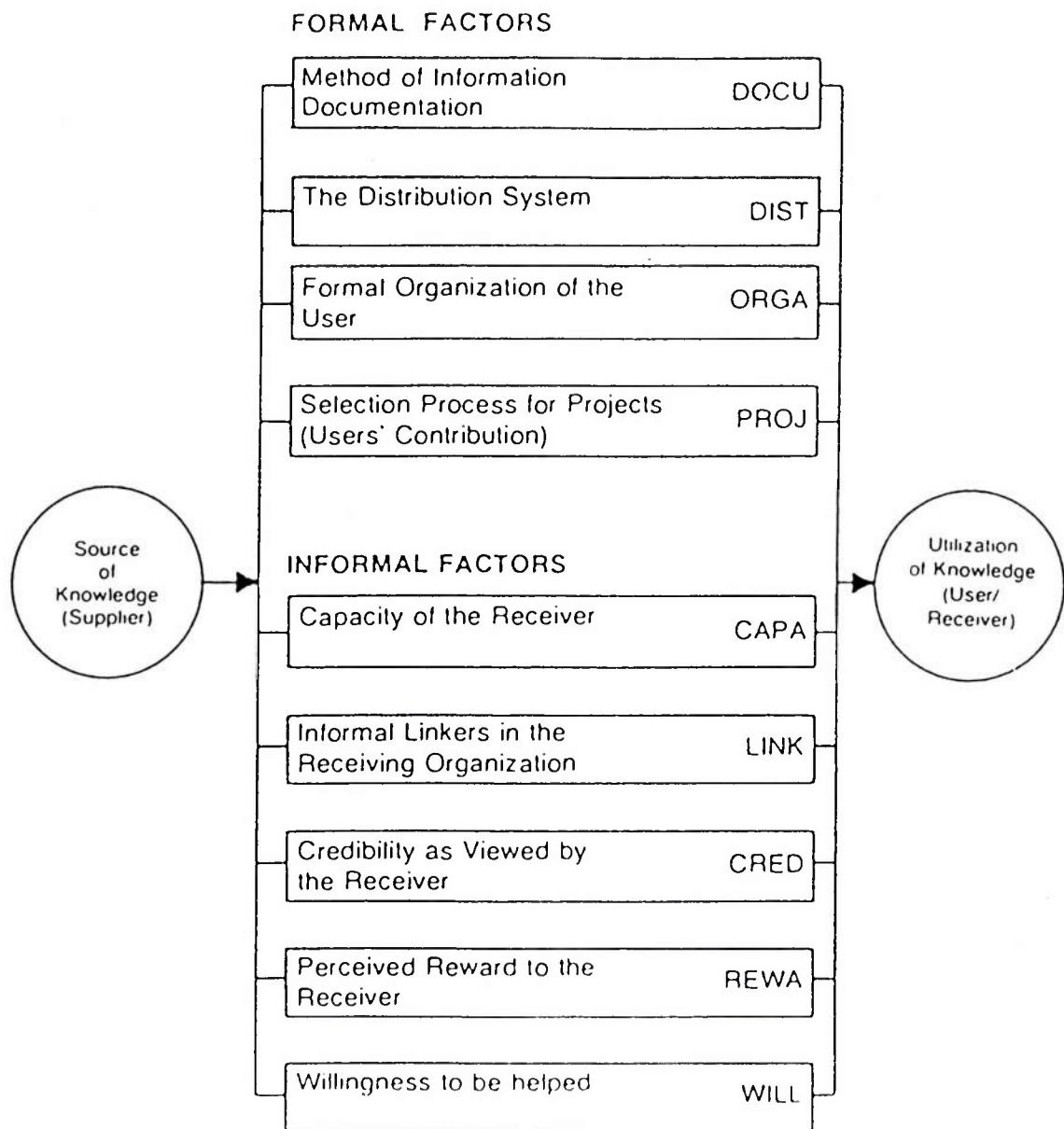


Figure 2. A Model of Technology Transfer.
(Jolly, 1980.)

However, ". . . the stable state as applied to organization, is the enemy of adoptive change . . ." (Schone, 1967). Stephenson, Ganz, and Erickson (1974) reported the responses of 109 scientists and engineers from the Naval Weapons Center, China Lake, California in terms of their perceptions of management creating conflicting forces for change. Forty respondents felt that their organization occasionally or often acted as a barrier to the use of new ideas.

4. Project Selection Process. Rogers and Jain (1969) have shown that ". . . a basic reason for the lack of research utilization is that the process is often begun with the research process, rather than the client's needs . . .)." There is an obvious benefit of increasing the potential utility of research through collaboration. In addition, users or receivers become more committed much earlier to the technology transfer effort.
5. Capacity of the Receiver. This factor refers to the ability and capability of the potential user to utilize new and/or innovative ideas. There are three aspects of capacity to consider, i.e., skills, education, and traits.
6. Informal Linkers in the User Organization. This refers to the presence of, and/or the effects of individuals in the receiving organization who link or couple persons in their organizations to outside ideas, concepts, and new devices. Linkers are persons who operate in the same organization or allied organizations (with social overlap) as those persons who will actually use the new technology.
7. Credibility as Viewed by the Receiver. The receiver will consciously or unconsciously assign a credibility to the technical information that relates to potential innovations. Because individuals have difficulty distinguishing between the source or origin of the message and the channel that carried that message, the individual will attach a composite credibility to a message, derived from both perceived source and perceived channel reliability. Thus, the character of the group or individual originating the idea or performing the research and development function in the vehicle (person or mechanism) transporting the information, will be important factors in determining how fast the idea, concept, or device gets adopted.
8. Perceived Reward to the Receiver. As Lingwood and Morris (1976, page 121) commented, ". . . rewards are the glue which holds organizations together and provides the response to individual needs for recognition of accomplishments . . .". Conventional wisdom reminds us that how the rewards structure of an organization is

perceived by an individual will have a great impact on idea flow and the adoption of innovations. . .

9. Willingness to be Helped. Willingness relates to the individual's ability and/or desire to accept change. Awareness, even first-hand knowledge of a new and/or innovative idea, is not sufficient to ensure its use. There must be a willingness and interest or, perhaps more significantly, an internal motivation to utilize a better method, process, or device.

A review of this model and the series of studies related to it proved useful because of the close conceptual relationship to prior training device acceptance research, and because the Navy organizational elements which were studied or used as a backdrop for the Naval Postgraduate School's investigations of technology transfer (e.g., those related to civil engineering) were in general different from those on which we have focused. This provided a broadened perspective from which we were better able to look for generalizability in the course of the present research.

ORGANIZATIONAL DEVELOPMENT

The literature on organizational development is concerned with improving organizational effectiveness through a variety of strategies and techniques directed at inducing change in such areas as: job attitudes, worker motivation, leadership, management style, quality of working life, information systems; decision making practices; social environments; and factors influencing resistance to change. (Bowers and Franklin, 1973; Evans, 1967; Applewhite, 1965; Fredericko, Brun and McCalla, 1980; Cummings, 1980; Faucheuex, Amado and Laurent, 1982; and Mitchell, 1979).

A comprehensive review of this very large literature was outside the scope of this project. Although it is likely that all of the above factors influence the working effectiveness of Navy organizations, we concerned ourselves with a subset of this literature which appeared to be particularly relevant to organizational processes associated with training device design and innovation. Some recent efforts to relate general systems theory (GST) to organizational development (Cummings, 1980; Lundberg, 1980) seemed especially helpful. As noted by Lundberg, GST, which is currently popular in the field of management, is useful in fields whose phenomena are not easily explained by mechanical or probabilistic approaches. Organizations are viewed as open systems. In contrast to "closed" systems of interrelated parts which function within themselves and independently of their context, "open systems," are comprised of interdependent parts which accept from, respond to, and export matter, information, and energy to their environment. In addition, a system may be "adaptive", where the parts exhibit an ordered pattern of activity which is congruent with certain system ends. Open, adaptive systems have a dynamic structure and not only exchange matter and energy with their environment, but also information which may serve as feedback (Lundberg, 1980). We view the Navy's training device development and procurement "organization" as an open adaptive system, even though it may be a loosely coupled one.

Several concepts from GST that appear particularly appropriate will be discussed. First however, it is necessary to observe that whether the Navy has an organization responsible for training device design and development can be questioned. An examination of the acquisition process (see Section 3)

reveals that the Navy training device organization can better be described as a loose affiliation of several sub-organizations with more or less separate responsibilities for need identification, funding, conceptualization, design, development, construction, test, use, and support. Further, the particular mix of Navy organizations involved in these activities depends partly on whether the device is being procured for the air, surface, or submarine components of the Navy and partly on the initial stimulus for the device (i.e., major weapon system development vs. myriad other training requirements that may be identified by any fleet activity or Navy command). The degree to which various Navy agencies get involved in various phases of the acquisition process can be almost unique to each training device. Indeed, the "first article trainer" is governed by a different set of procurement rules (those for R,D,T &E) than are follow-on trainers. This has significant implications concerning the responsibilities and levels of authority that various Navy sub-organizations have, regardless of their eventual stake in trainer use and effectiveness. In the view of some it argues for substantial change in the way responsibilities are assigned during the early phases of the acquisition process. (Nutter and Terrell, 1982. See also Appendix C).

A related general observation is that not all of the organizations involved in training device procurement have the same goals and reward structure. While all involved parties might agree that the objective is to develop the trainers that will deliver the most effective device for meeting fleet readiness requirements, it is not at all clear that the rewards associated with this long-term objective are the most compelling ones considering the feedback loops that appear to govern shorter-term organizational behavior. In fact, it seems likely that shorter term

objectives associated with time and budget constraints may have a more profound impact on organizational behavior than does the presumed ultimate objective of producing effective training devices. In this respect, the Navy's training device acquisition organization is very different from industrial organizations. The rewards to be obtained are only remotely associated with customer satisfaction in the market place, and that market place is non-competitive. Indeed, many of the players who are involved early in the design and development process may have entirely new sets of responsibilities and interests by the time the product is delivered. This, we hypothesize, has pronounced effects on the behavior of the Navy's training device acquisition organization and it is in this sense that some of the GST concepts appear to be helpful.

It is a characteristic of open adaptive systems that, over time, considerable autonomy of certain components of the system may develop, even when there is intercomponent interaction (Lundberg, 1980). This is the result of "codes" developed in the system as to what constitutes appropriate feedback information (Lundberg, 1980). Feedback codes that relate directly to desired system states control the system, and in this sense the system actions are goal directed. Some components of the system, because they design and monitor feedback, become relatively influential. In this regard, Lundberg cites "Pareto's Law" to the effect that a relatively small percentage of inputs creates a relatively large percentage of outcomes. This seems to us to apply in the case of many Navy training device developments, and the model we have developed expressly takes this potential problem into account.

Feedback information is a pivotal idea in general systems theory and, it is also central to the model of training device development and acceptance developed during this study. In the systems context, the actual performance of a system (the training device organization) is compared with a predetermined desired state and information about any deviation between the two directs the system into closer correspondence. Feedback which counteracts deviation is called negative feedback. In contrast, positive feedback is information about system actions that increases the deviation of the system from its predetermined goal state (Lundberg, 1980). Organizational behavior can change through the application of either negative or positive feedback. In fact, Lundberg points out that planned change relies on negative feedback, which serves to reduce deviations from existing goals established by managers who presumably know best. But organizational development that is, in Lundberg's terms, moving an organization into unanticipated new environments or states, or causing it to reorganize its components for better goal seeking requires positive feedback as well. Conceptually, these notions appear to relate to our concern with how innovative technology and the outputs of research actually find their way into the design of new training equipment. It seems certain that most military organizations operate primarily on negative feedback and we certainly see the Navy's training device acquisition process as being dominated by management actions aimed at keeping system behavior in close correspondence with preconceived states. If acceptance of innovation implies deviation of the organization from its predetermined goal states and traditional reward structure, then hard sledding for innovative technology and new concepts is certainly to be predicted.

Another important concept of GST in the context of organizational development is that the target of change is less often the people in the system whose attitudes, leadership styles, or whatever may benefit by change, but rather the targets are system processes. Included in these are informational processes which, Lundberg (1980) feels, may be more fruitful targets than the individuals themselves. Thus the creation, utilization and extinction of various feedback loops become the focal point for managing both change and development. Intervention processes are now seen as involving the alteration of feedback loops both within and between various system components. The creation, utilization, and extinction of feedback loops is seen as the means by which both progressive change and real development take place. Most interventions are seen by Lundberg as involving negative feedback loops. But, as noted, the theory suggests that positive feedback is a necessary condition to drive the organization toward an alternative state. Of course, even organizations that are in the process of developmental change maintain many negative feedback loops or else the organization would go out of control.

Most organizations in the modern world have multiple goals, some of which may not be clear. In addition, as Lundberg (1980) notes, most organizations are not specified completely. Certainly, we view these as two characteristics of the Navy's complex organizational structure for acquiring training systems. This suggests that some components and processes will not be under feedback control. One of the problems of a managed, planned change strategy is that it may thus deal with only the tip of the organizational iceberg (Lundberg, 1980).

The system-component relationships in an organization differ in degree of coupling or amount of dependence and interaction. Further, organizational boundaries vary in permeability. We see both of these characteristics in Navy training device acquisition. The degree of organizational coupling is a function of information flow which of course involves many feedback loops. Our model attempts to reflect these characteristics.

Lundberg quotes Argyris (1970) to the effect that the generation and use of valid data about organizational functioning is the central defining characteristic of organizational development. Trying to describe the functioning of the Navy's training device acquisition "organization," and how it relates to innovation and change has been a major objective of the present project and it has turned out to be a far more complex matter than we originally envisioned. As noted earlier, there is not just one functioning organization--there are many. This will be discussed in detail in Section 3.

REVIEW OF OFFICIAL DIRECTIVES AND INSTRUCTIONS

There are many official directives and instructions bearing on the training system acquisition process. The titles of those we have reviewed are given in Appendix A to give the reader a feeling for the subject matter. These directives and instructions represent a substantial body of official policy, and it might be thought that review of these materials would reveal the Navy's training system design, development, procurement, introduction, and use processes. However, it was clear from our interviews with various members of the Navy's training device acquisition organization that a clear understanding of how things are "really" done can't be gained by reading these

directives and instructions. Certain directives and instructions represent a codification of processes that are well established and working smoothly and uniformly. Others represent idealized procedures which may differ substantially from actual practice. In every case, it has been our experience that personal interviews with people involved in particular processes were necessary to gain an understanding of current practice and future directions.

SECTION THREE

OVERVIEW OF THE ACQUISITION PROCESS

During this project, we conducted 51 meetings in which we interviewed 76 persons from OPNAV, NAVSEASYSOM, NAVAIRSYSCOM, NAVEDTRACOM, NAVTRAEEQUIPCEN, ASWTRACENPAC, SURFPAC, SUBTRAFAC, ASWINGSPAC, SUBGRU5, and members of Fleet Project Teams representing 25 different training devices in various stages of development ranging from pre-contract to obsolescence. Some additional detail regarding these interviews is given in Appendix B.

The intent of these interviews was to obtain the personal observations of people who are working directly in training system research, development, acquisition, management, and/or use. We experienced a very high degree of cooperation, and found that most interviewees had well formed--and often very strong--attitudes and beliefs regarding factors that influence training system design, innovation acceptance and use. The results, while not quantitative, represent an important body of data concerning the organizational processes involved.

In this section, we present some of what was learned from these interviews in the form of an overview of the training system acquisition process that attempts to identify most of the important players. We necessarily must present a relatively generalized description, because the detailed organizational interactions are complex, often subtle, and vary considerably among trainers depending upon a surprisingly large number of unique factors.

Then, in Section 4, a preliminary model of trainer utilization and innovation acceptance is presented, and in Section 5, many of the more important interview results are presented in the form of quotations (unattributed, of course) which are examined in the context of the model.

STIMULI FOR ACQUISITION OF TRAINING SYSTEMS

The three major reasons for acquiring new training systems are 1) to provide initial training capability for new weapons systems 2) to provide improved or expanded training capability and 3) to provide a vehicle for training technology research and development. The latter two stimuli sometimes go hand in hand; certainly they can support one another.

New training systems arising in response to the first need mentioned above, to provide training capability in support of any training objective, for a new weapon system, generally are subject to a set of constraints which are quite different from those associated with training systems arising from the second two stimuli. This is a consequence of the training system being "driven" by a weapon system acquisition. Generally, a new weapon system acquisition is a very expensive and visible enterprise, compared to typical training system acquisitions. Training system acquisition which is associated with a major weapon system acquisition can sometimes benefit from the high priority and substantial "power" which typically accrues to the latter; however, the training system acquisition often is also subjected to substantial pressure, usually in the form of time and budgetary constraints, because of its subordination to the weapon system project.

ORGANIZATIONAL RELATIONSHIPS

Figure 3 shows tentative "organizational envelopes" that identify major players and relationships in training system acquisition and use. These players and relationships will be discussed in turn below.

RDT&E,N Fund Flow

Research and development in the Navy is funded under the "Research, Development, Test, and Engineering, Navy" (RDT&E,N) account. Since August, 1977 first-article trainers must also be funded under the RDT&E,N account, rather than procurement accounts, in order to create better control and systematic development. This requirement imposes significant constraints on first-article development and on follow-on trainers. Consequently, the offices which monitor and control RDT&E,N funds play an important role, not only in more "basic" research and training system innovation, but in first-article operational trainer development as well.

The offices concerned with RDT&E,N funds are shown in the top line of blocks in Figure 3. Most of these offices have some impact on all R&D and first-article trainers, and substantial impact on selected trainers. The offices include: The Office of the Undersecretary of Defense for Research and Engineering; The Office of the Comptroller of the Navy; the Assistant Secretary of the Navy for Research, Engineering, and Systems; The Office of Naval Research; and the OPNAV office of Research, Development, Test, and Engineering (OP-098). These offices have a very substantial and active influence on training system innovation, and informal communication among key members of these offices and with some of the other players shown in Figure 3 is a very important factor.

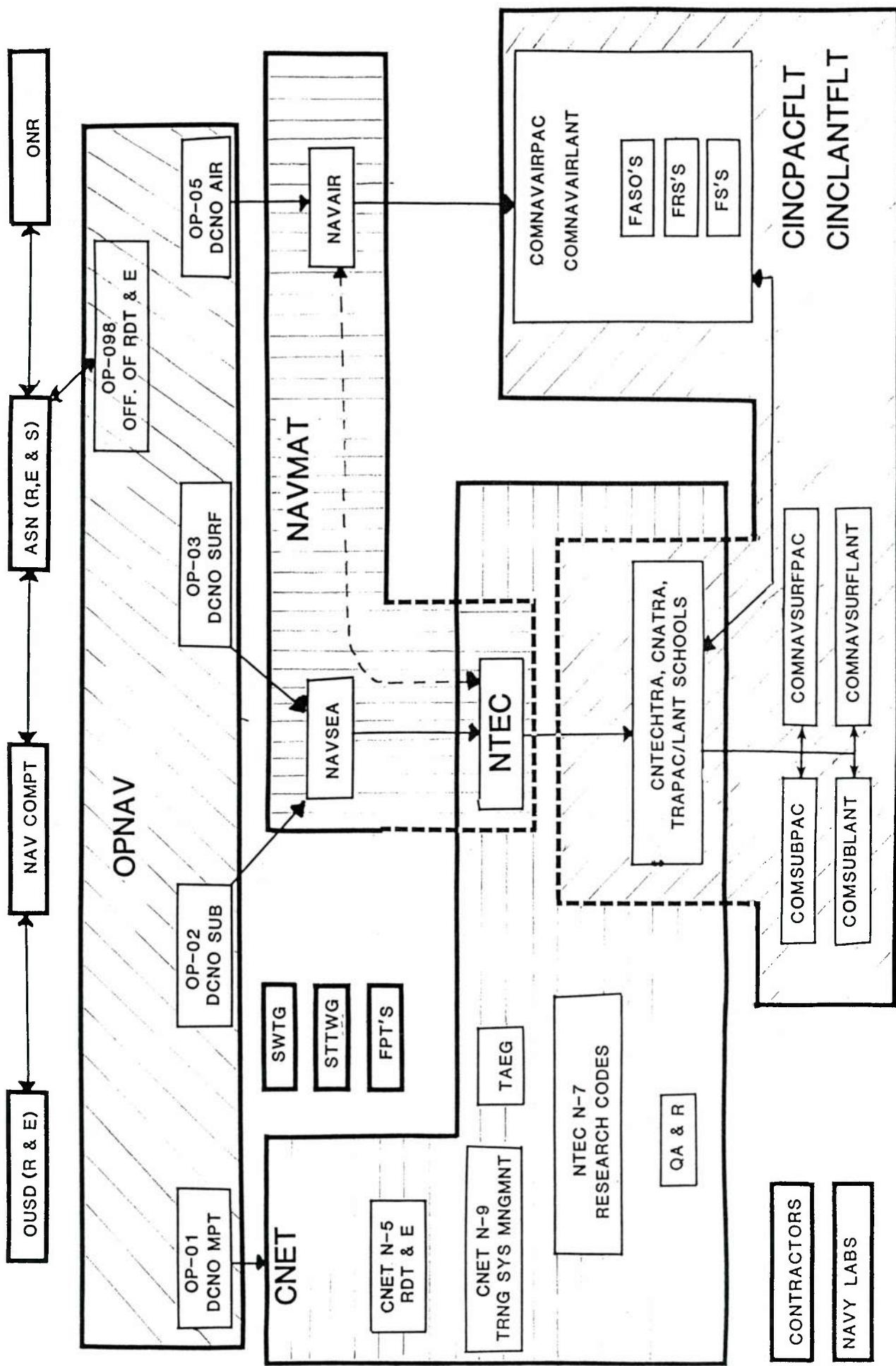


Figure 3. Organizations and relationships in training system acquisition and use.

Office of the Chief of Naval Operations

All training system acquisition projects must have appropriate sponsors within The Office of the Chief of Naval Operations (OPNAV). OPNAV resource sponsors include OP-01, OP-02, OP-03, and OP-05. Each will be discussed in turn.

OP-01: Deputy Chief of Naval Operations, Manpower, Personnel, and Training. Within OP-01, the current Research, Development and Studies Branch (Code OP-115) deals with trainers. OP-115 sponsors training technology research and development (6.3 funding), and interacts with and sponsors CNET Code N-5 and NAVTRAEEQUIPCEN Code N-7, which are represented in Figure 3. OP-115 maintains an awareness of Office of Naval Research 6.1 and 6.2 programs in order to plan for appropriate 6.3 programs. OP-115 also sponsors some 6.4 training developments where these developments are generic and/or do not clearly fall to a particular warfare area sponsor (i.e., OP-02, OP-03, or OP-05).

OP-02: Deputy Chief of Naval Operations, Submarine Warfare. Within OP-02, Manpower and Training Requirements Division (Code OP-29) sponsors trainers for submarine systems. OP-29 tends to buy trainers as parts of prime weapon system acquisition, assigning responsibility for the acquisition trainers to Naval Sea Systems Command.

OP-03: Deputy Chief of Naval Operations, Surface Warfare. The Manpower and Training Requirements Division, OP-39, sponsors trainers in the surface warfare area. OP-39 typically maintains close liaison with Naval Training Equipment Center (NAVTRAEEQUIPCEN) regarding surface trainer development.

OP-39

frequently buys trainers as commodities separate from weapons systems, using NAVTRAEEQUIPCEN as the developing agency.

OP-05: Deputy Chief of Naval Operations, Air Warfare. The Aviation Manpower and Training Division, OP-59, sponsors air trainers. OP-59 frequently relies heavily on Naval Air Systems Command's Weapons Training Division (AIR-413) for trainer requirements, design, and acquisition. OP-05 tends to buy trainers as part of the prime weapons system acquisition.

Naval Material Command

The Naval Material Command (NAVMAT) provides for the total system and material support needs of the operating forces of the Navy for equipment, weapons and weapons systems, materials, supplies, facilities, maintenance, and supporting services. (U.S. Government Manual, 1978). As a "training support agent" (NAVCOMPT Manual 075148), the Chief of Naval Material provides initial⁴ training, equipment, and materials, often via Naval Training Equipment Center, which is under the command of the Chief of Naval Education and Training, but which is assigned for additional duty to the Chief of Naval Material and others (CNETINST 5450.8/NAVMATINST 5450.28). As may be seen in Figure 3, the Chief of Naval Material delegates authority to fulfil his training support agent role to the Naval Sea Systems Command (NAVSEA) and Naval Air Systems Command (NAVAIR).

⁴"Initial training" is that training performed by the Training Support Agent [eg., NAVMAT] pending the opportunity for the Training Agent [eg., CNET] to acquire the capability for training (OPNAVINST 1500.8J). The training which the Training Agent performs is referred to as "follow-on training."

Naval aviation has a lengthy history of utilizing training devices, to a greater degree than in the surface and submarine warfare areas. Consequently, Naval Air Systems Command, both by custom and the development of technical expertise, often exercises a substantial degree of autonomy in developing training devices for naval aviation. This is reflected in Figure 3, which shows a direct line of training system support from NAVAIR to the Air Type Commanders (i.e., COMNAVAIRPAC and COMNAVAIRLANT), with the a dashed line representing "technical assistance" by NAVTRAEOUIPCEN. AIR-413, Weapons Training Division, is responsible for trainer acquisition (6.4 funding). AIR-340, Equipment and Support, is responsible for trainer technology programs (6.3 funding).

Naval Education and Training Command

The Chief of Naval Education and Training (CNET), under the Chief of Naval Operations, is responsible for assigned shore-based education and training of Navy personnel; develops specifically designated education and training afloat programs for the fleets, participates with research and development activities in the development and implementation of teaching/training systems and devices for optimal education and training; and executes a number of other Navy education and training responsibilities. CNET, as a training agent, provides follow-on surface and submarine trainers and training via Naval Training Equipment Center (NAVTRAEOUIPCEN) and various functional commanders (eg., COMTRAPAC, COMTRALANT, CNTECHTRA), as discussed below.

Naval Training Equipment Center (NAVTRAEOUIPCEN). NAVTRAEOUIPCEN reports to CNET, but has additional duty tasking to NAVMAT, indicated in Figure 3 by

the dashed NAVMAT organizational boundary line enveloping NAVTRAEEQUIPCEN. NAVTRAEEQUIPCEN is recognized as the Navy's primary technical agent for training devices (Nutter and Terrell, 1982). Specific functions and responsibilities of NAVTRAEEQUIPCEN as derived from CNETINST 5450.31a and other directives, include:

- o perform functions in support of CNET, CHNAVMAT, SYSCOMs, PMs, and other activities in the design, development, acquisition, and logistics support of training devices and equipment
- o identify resource requirements for training device initial spares, modification, and factory training
- o assist CNET and functional commanders in initial analysis of training device needs
- o perform technical assessment of training device feasibility, cost, approaches and alternatives
- o provide facility, personnel and OPTAR requirement criteria to functional command training activity
- o participate in Submarine Trainer Working Group and Surface Warfare Trainer Group functions
- o perform training device engineering development functions including front-end analysis, planning, engineering, logistics, and contracting
- o perform equipment test and evaluation
- o conduct training research (in-house and contract)
- o establish functional baseline
- o develop Program Master Plan
- o develop POM justification data

CNET Functional Commands and Schools. CNET's functional commanders include the Chief of Naval Technical Training (CNTECHTRA), Chief of Naval Aviation Training (CNATRA); Commander, Training Command, U.S. Atlantic Fleet (COMTRALANT); and Commander, Training Command, U.S. Pacific Fleet (COMTRAPAC). They are responsible to CNET for conduct of the training and identification of all resource requirements to support that training. In

addition, training curriculum control authority resides within the functional command. The functional commanders have numerous training activities or schools which are responsible to them and which support training directly. It is in these schools that training devices, instructors, and students come together, comprising the ultimate "point of training." As shown in Figure 3, the major training support for the submarine and surface type commanders (COMSUBPAC/LANT, COMNAVSURFPAC/LANT) is provided by CNET's schools, which in some cases have additional duty tasking to the type commanders, as shown by the dashed line of Figure 3 which envelopes the schools.

However, the majority of advanced training support for the air type commanders (COMNAVAIRPAC/LANT) is not provided by CNET's schools; the air type commanders provide for most of their own training organically (ie., within their own commands, by the Fleet Aviation Specialized Operational Training Groups (FASO's), the Fleet Replacement Squadrons (FDS's) and Fleet Squadrons (FS's), discussed later), with close support from Naval Air Systems Command, as shown in Figure 3. Frequently, NAVTRAEEQUIPCEN offers direct support to the Air type commanders as well, particularly where NAVTRAEEQUIPCEN was the trainer developing agent.

CNET R&D. CNET has a substantial R&D responsibility, and a substantial responsibility in facilitating the transfer of RDT&E results from one funding category to another. As Nutter and Terrell (1982) observed

CNET N-5 (Research, Development, Test and Evaluation) has cognizance of 6.1, 6.2, and 6.3, the technology based development categories; and CNET N-9, Training System Management, has cognizance over 6.4, the hardware based operational capabilities development category for training devices. CNET N-9 is also responsible for the planning and programming for associated resources in other appropriation categories (i.e., MPN, OM&N, and MILCON). It is obviously important to maintain good communications between N-5 and N-9 to ensure the flow of technology base information from technology development to engineering, and technology requirements from engineering to technology base development.

NAVTRAEOUIPCEN also conducts a substantial research program, and the comment above regarding coordination between CNET codes N-5 and N-9 certainly extends to the NAVTRAEOUIPCEN N-7 research codes as well.

Quality Assurance and Revalidation. CNET has a Quality Assurance and Revalidation (QA&R) program which inspects all major training devices in the field periodically with respect to material reliability, utilization, configuration management, achievement of training objectives, and other factors. The QA&R program is intended to be responsive to the needs of the users (i.e., the type commanders and the training commands) and frequency of inspection is based on inputs from them. The results of QA&R inspections are sent to these users and also to CNET, NAVTRAEOUIPCEN, the appropriate Systems Command and others. The QA&R program provides a formal method for evaluating and feeding back user complaints and trainer and/or support deficiencies.

The Fleet

The Fleet Commanders-in-Chief (CINCPACFLT, CINCLANTFLT) rely substantially on the Chief of Naval Material (CHNAVMAT) and the Chief of Naval Education and Training (CNET) for initial and follow-on training. Figure 3 indicates some of the relationships involved. The submarine type commanders (COMSUBPAC, COMSUBLANT) and the surface type commanders (COMNAVSURFPAC, COMNAVSURFLANT) make extensive use of training ashore provided by CNET's functional commanders (CNTECHRA, COMTRAPAC, COMTRALANT, etc.). The air type commanders (COMNAVAIRPAC, COMNAVAIRLANT) provide much more of their training internally. The FASO's are the custodians and maintainers of AIRPAC/LANT trainers. The FRS's provide replacement training using the trainers, and focus on safety and training in fundamentals. The FS's use the trainers to provide advanced training.

Surface Warfare Trainer Group (SWTG) and Submarine Training/Trainer Working Group (STTWG)

These working groups were established by the Chief of Naval Operations to provide and promote communications and to provide a forum for identification and resolution of major trainer problems and issues. The working groups generally meet twice a year and involve a wide spectrum of members, representing OPNAV, SYSCOM's, CNET, various schools, the fleet and Naval Training Equipment Center. The working groups identify trainer needs, consider alternatives, prioritize trainer projects, and make recommendations concerning Fleet Project Teams. The working groups provide an important forum for the exchange of information and they also serve to enhance innovation acceptance by providing for user involvement.

Fleet Project Teams

The Fleet Project Team concept is officially instituted in OPNAV Instruction 1551.7, "Fleet Participation in Development, Acquisition, and Acceptance of Major Training Devices." In that instruction, the Fleet Project Team is defined to be "a group of knowledgeable representatives from the fleet or other user and interested non-user activities, consisting of qualified military and/or civilian personnel designated by cognizant commands. The FPT will assist and advise the Training Device Development and Acquisition Activity in development, acquisition, and acceptance of specifically designed training devices." A copy of this instruction is provided in Appendix C, and the reader will see from the definition of the Fleet Project Team's role,

functions, and duties, that it may play a very important role in training device development, acquisition, and introduction, depending on how many of the duties listed are actually assigned to the FPT and whether the FPT has available to it the resources to properly discharge these duties.

Contractors

In most cases, the Training Device Development/Acquisition Agent (e.g., Naval Training Equipment Center, Naval Air Systems Command, etc.) will contract with a private-sector organization for the actual construction of a training device. Sometimes, the prime contract for a weapon system will include development and delivery of a supporting trainer or trainers and training materials. In any event, a contractor almost always plays a major role in the final realization of a training device. Since a training device is rarely specified to minute detail in a Request for Proposal (RFP), the contractor often has considerable opportunity to be innovative in his design of the desired product. Because of this freedom, the Navy realizes certain benefits. For example, much of the innovation in training technology which finds its way into Navy training devices comes from trainer contractors as a consequence of the competitive procurement process, which encourages technical creativity and rewards it. On the other hand, there are some negative aspects: There is considerable variability among contractors' abilities to perform on-time, within budget, and to a high standard of technical quality. Unfortunately, it is not always possible to predict how well a contractor will perform. Consequently, contractors introduce considerable variability into the acquisition process.

Navy Laboratories

A number of Navy laboratories contribute to innovation in training devices. Among these are Naval Undersea System Center (Newport and New London), Naval Ocean Systems Center, Naval Personnel Research and Development Center, and Naval Air Development Center. The role which Navy Labs play, if any, with regard to a specific trainer is unique for that trainer. It may be major, or of little consequence.

CRITICAL IMPACT OF TIME CONSTRAINTS

Pervasive throughout the acquisition cycle of trainers intended to support new weapon systems is the race to meet deadlines. This time pressure can have adverse consequences on the systematic and orderly development of training systems. As Nutter and Terrell (1982) observe:

Two critical time constraints are, from a practical standpoint, not likely to be subject to change. They are (1) that time point in the weapon system acquisition cycle when the training equipment must be onsite and ready for training (RFT) and (2) the time required to complete the programming and budgeting cycle. The weapon system or equipment program manager normally establishes the training equipment RFT date. This date must be met if trained personnel are to be available to operate and maintain the system or equipment when delivered and if CNET is to meet pipeline training requirements. Failure to meet the RFT date severely restricts the capability of the operational forces to meet their mission commitments.

For major training device (prototype) programs, OPNAVINST 1500.8 states that the minimum lead times required to meet RFT dates are (1) 5 years for military construction projects (2) 4 years for major training devices, and (3) 3 years for billets and expense dollars. Historical evidence suggests a 5-year phasing between POM input and training device RFT for major prototype RDT&E devices to be more realistic. The NAVCOMPT Manual 075148 states that follow-on devices can only be programmed in years subsequent to the successful demonstration of the prototype unit. The CNO resource sponsor determines what constitutes a successful demonstration. This may take place at the prototype RFT date or 1 year prior at design approval.

These programming and budgeting time requirements place severe limitations on the time available to perform the various training system design analysis functions required prior to identifying the training device requirement. Technically, these analysis are performed prior to the POM submission, a period when technical details relating to the weapon system or equipment are typically minimal. From a practical standpoint then, data necessary to complete all of the stipulated tasks prior to initiating the training device acquisition process are not available when required. Therefore, modified analyses, based on earliest information available and made progressively more definitive as the weapon system or equipment program progresses, should be used for initiating training equipment acquisition programs (i.e., POM submittal).

Another factor related to front-end training analyses concerns the availability of funds often required for the conduct of such analyses. Due to manpower limitations and commitments, front-end analyses cannot always be conducted in-house; contractor effort is sometimes required to support front-end training analyses efforts. The present procedure for POM submission for prototype training device acquisition is not sufficiently early to provide funds for all required front-end training analyses.

Obviously, compromises in systematic training system development may unfavorably impact the likelihood of fully satisfactory user acceptance.

IN SUMMARY

The Navy's training system development and acquisition "organization" is very complex, indeed, and is perhaps best described as a loosely-coupled federation of organizations whose linkages vary on an ad hoc basis depending on many factors.

In the next section, a model is presented which attempts to simplify and generalize organizational and device-specific factors which we hypothesize are most important in achieving satisfactory user acceptance of innovations.

SECTION FOUR

A MODEL FOR PREDICTING ORGANIZATIONAL ACCEPTANCE OF TECHNOLOGICAL CHANGE

Based on our review of the literature and Navy directives, as well as the interviews among representatives of the organizations identified in Section Three, we have developed a predictive model of innovation acceptance. The model has a component which is intended to reflect organizational factors and a second component to reflect specific features of innovations. The model is intended to be applicable to many different kinds of organizations; however, we took particular care to allow the model to accomodate training technology transfer and training innovation acceptance processes as we have observed them in the Navy.

RESEARCH UTILIZATION AND INNOVATION IN LARGE ORGANIZATIONS

In large organizations, such as the Navy, a number of distinct organizational entities may be involved in the research utilization and innovation process. Figure 4 presents a generalized organizational diagram depicting some important organizational units involved in the process of training system innovation and user acceptance. Each of these units will be discussed briefly.

The "funding organization" represents an executive function of approval and funding, and of overall program planning, but with relatively little

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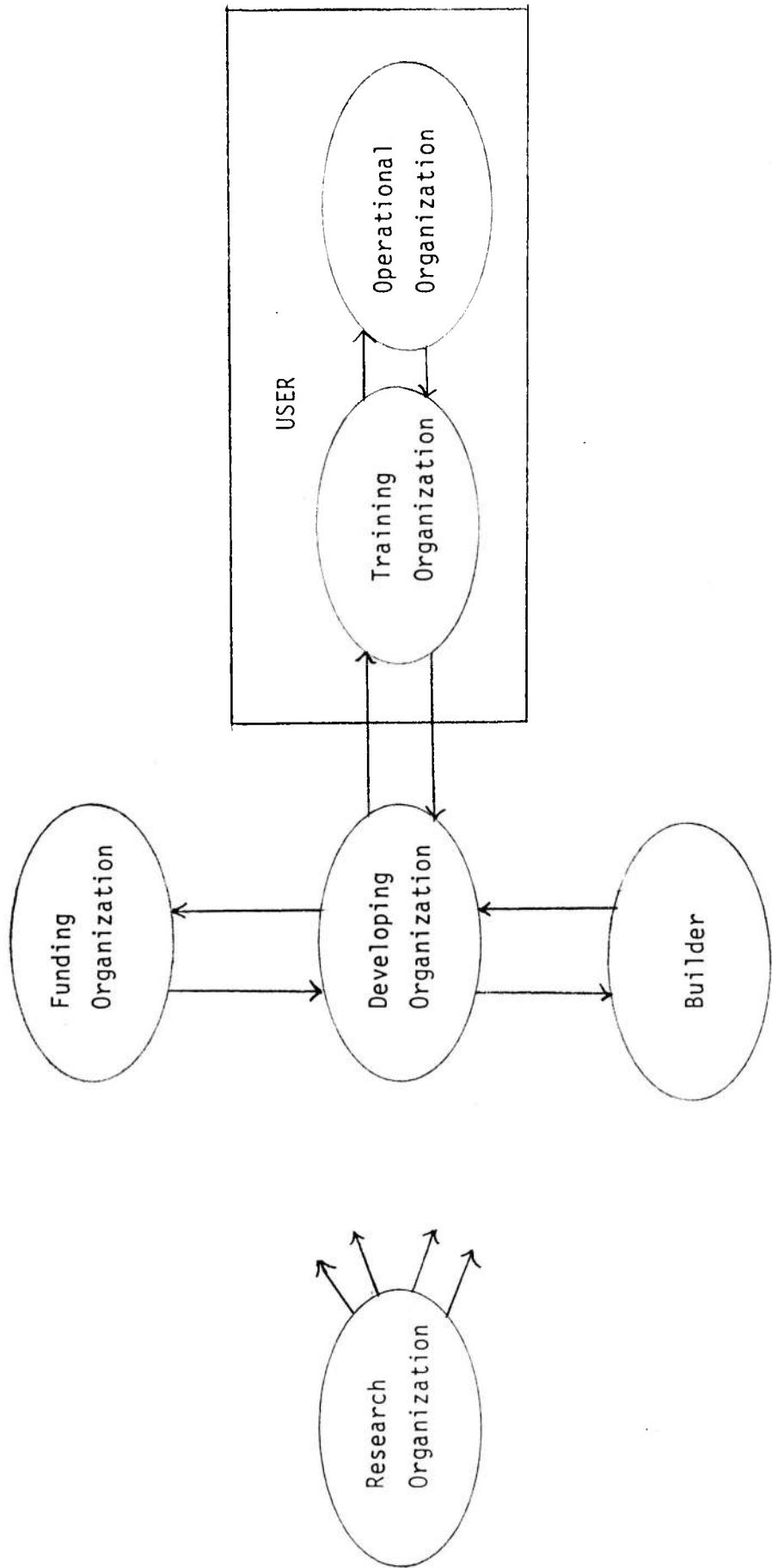


Figure 4. Generalized organizational diagram

involvement in the details of technical development. The analogue of this entity in the Navy is the Office of the Chief of Naval Operations.

The "developing organization" is the focal point of the research utilization and trainer innovation process. Typically, the developing organization anticipates needs, gets projects officially recognized and funded by the funding organization, develops the functional specifications of an innovative device, contracts with a "builder" to produce a tangible product, and delivers the product to the user. Analogues in the Navy of this organizational element, depending on a variety of factors, include Naval Training Equipment Center, the Systems Commands, and sometimes the Navy laboratories.

The "builder" is that organization which implements the functional specification to produce a tangible product. Most often, the Navy's "developing organizations" select and contract with private sector organizations to fulfill the builder function, although occasionally the function may be performed by a Navy laboratory or other activity.

The "user" is, of course, the agency which puts an innovation to practical use and which, in varying degrees, accepts or rejects it. In our field interviews, we concentrated on innovations in Navy training systems, and in that connection found two important organizations which together may be considered to comprise the user. The first is the training organization, whose primary objective is to train, and it employs innovations in training systems in accomplishing that goal. In doing so, it supports the other "user," namely, the operational organization. The role of the operational

organization is to pursue the primary objectives of the enterprise as a whole, and it is supported in doing this by the training organization. Both are users of, and acceptors/rejectors of, training system innovations. Examples in the Navy of the training function include the Naval Education and Training Command and its various functional commands and schools. Examples of the operational organization in the Navy include the Atlantic and Pacific Fleets.

The "research organization" performs the function of generating innovative knowledge. Research organizations may exist as subunits of the organizational elements discussed above. For example, in the Navy, a "developing organization" (Naval Training Equipment Center) and a "training organization" (Naval Education and Training Command) have organic research organizations. Likewise, contractors often have in-house research organizations. Frequently, though, even research organizations which are organic to the funder, developer, builder, or user nonetheless retain a somewhat distinctive character; and sometimes they may be organizationally quite distant from the other players.

ORGANIZATIONAL INTERACTION MATRIX

We believe that any model which attempts to deal successfully with technology transfer in large organizations must not deal simply with a "giver" of innovative information to a "receiver." Models which involve only two parties (giver and receiver) are bound to overlook some of the important organizational interactions and necessary feedback processes which bear upon research utilization and innovation acceptance.

Figure 5 presents an organizational interaction matrix, which depicts schematically the organizational interactions among units of the type shown in Figure 4 (i.e., researcher, funder, developer, builder, user). Each cell of the matrix represents an interaction between a player "X" (listed on the left side of the matrix) and a player "Y" (listed across the top of the matrix). In order to understand the process of generating innovative knowledge, reducing it to practice, introducing it to users, and gaining acceptance, we believe it is necessary to consider a variety of interaction factors for most, if not all, of the possible pairings of X and Y depicted in Figure 5. We will turn our attention to these interaction factors.

ORGANIZATIONAL INTERACTION FACTORS

On the basis of the literature review and our first-hand observations, we believe that the nine organizational interaction factors shown in Figure 6 capture most of the important facets of organizational interaction as it impacts technology transfer. The first three factors (seek, hear, read) bear upon the ability and motivation (power, qualification, skill, willingness) of a "player" to receive innovative information; factors 4 and 5 (utilize, get reward) bear on the ability of the player to employ knowledge gained; and factors 6-9 (talk, write, show credibility, give reward) bear on the ability and motivation of a player to transmit innovative information effectively. We will discuss briefly each of these nine factors in turn.

RESEARCHER	FUNDER	DEVELOPER	BUILDER	USER
RESEARCHER				
FUNDER				
DEVELOPER				
BUILDER				
USER				

Figure 5. Organizational interaction matrix.

Seek

This factor has to do with the willingness and motivation of a player to seek innovation information actively. This seeking behavior is an important component of the ability of a player to serve in the role of a "linker" (gate-keeper, opinion leader) in technology transfer theory (Jolly, et. al., 1978). Our interviews have included, for example, instances where "developer" did not actively seek information from "researcher."

Hear/View and Read

"Hear/view" and "read" are separated in our model, because they require different degrees of effort and skill on the part of the receiver, and because the oral/demonstration form of communication has been found to be more effective than the documentary mode in regard to change advocacy (Rogers and Shoemaker, 1971). Motivation and ability to hear/view and to read innovation information are important aspects of the technology transfer and innovation acceptance process. We hypothesize that different groups (researcher, funder, developer, builder, user) have different preferences between the oral/demonstration and the written forms of communication, and that effective interaction among groups can be impaired if these preferences are not heeded.

Utilize

This factor refers to the capacity of a potential user of innovation information to employ that information in furthering the process of change.

Ability to utilize information successfully depends on such things as motivation, training, status and a variety of pre-dispositional variables (Jolly, et al., 1978).).

Get Reward

This factor refers to the ability of "X" to get reward (reinforcement, punishment) from a player "Y". Reinforcement is an important determinant of individual behavior in regard to change (and in general). Rewards are important elements of the feedback loops postulated in general systems theory to be necessary for altering organizational processes (Lundberg, 1980). However, not all "Y's" are able to provide the same degree of rewards to the "X's". For example, "developer" obviously gets reinforced by "funder," but in our observations the degree of reward "developer" feels he can get from "researcher" is at times quite small. Thus the ability of each X to get reward from each Y must be considered independently for each of the cells of the organizational interaction matrix shown in Figure 5.

Talk/Demonstrate and Write

These factors are the "transmitting" analogues of factors 2 and 3, "hear/view" and "read." Again, we differentiate between the methods of communication because of their differential effectiveness for various purposes, and because the preferred method may vary depending on which players interact (i.e., depending on which cell of the organizational interaction matrix one considers). For example, we have observed that some "researchers" prefer to communicate to "developers" via written technical reports, which

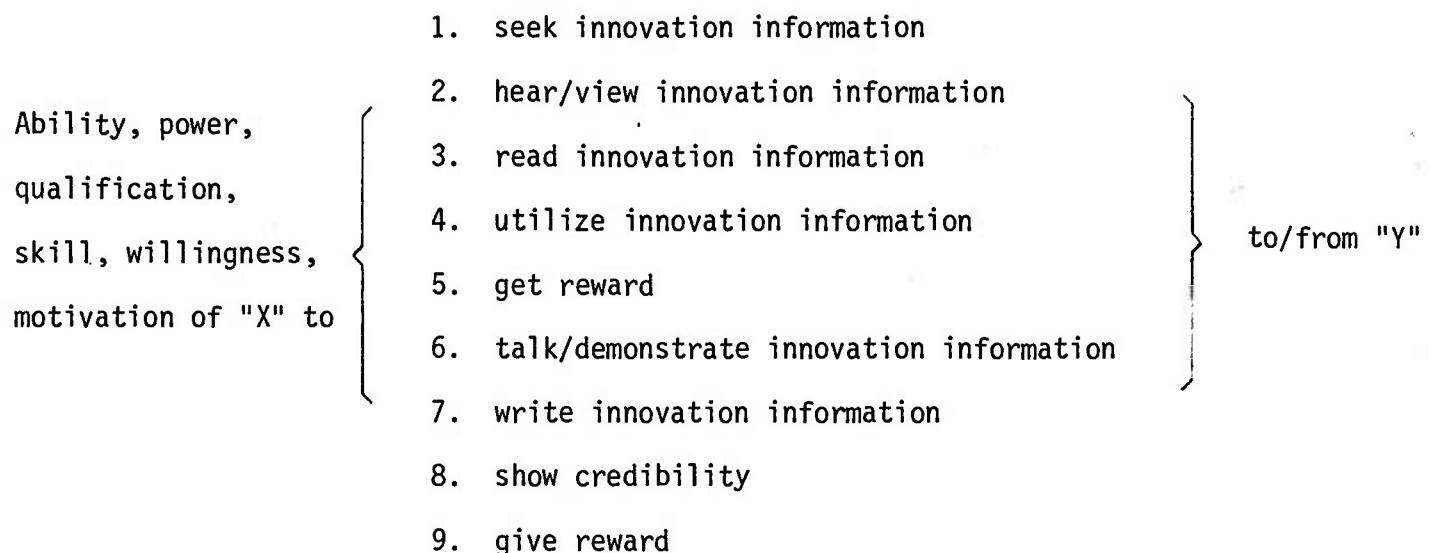


Figure 6. Nine organizational interaction factors.

may not be very effective when "developer" prefers to "hear/view" rather than to "read."

Show Credibility

Many investigators have found that the credibility of a transmitter of innovation information is an important factor in the behavior of the receivers of that information (Jolly, et. al., 1978). The ability of player X to show credibility to player Y will vary according to characteristics of the information source and personal characteristics of players X and Y (Jolly, 1980). We have seen examples where "researcher" has been able to establish credibility with "user" only by showing detailed knowledge of the user's operational problems.

Give Reward

This factor measures the ability of X to give reward to Y, which is to say, to reinforce Y's behavior positively (or negatively) in regard to the innovation. Clearly, as discussed under factor 5 (ability of X to get reward from Y), this is an important organizational interaction factor. Not all players in the organizational matrix are in a position to give reward to all other players.

INTERACTIONAL ASYMMETRY

The interactional variables include those related to "receiving" innovation information and those related to "transmitting" information, as

described above. Consequently, it might be assumed that after these nine factors have been evaluated for a given cell of the organizational interaction matrix (Figure 5), the relationship between player X and player Y would be adequately characterized, and therefore the cell associated with the converse relationship (player Y to/from player X) would be redundant. That is to say, it would be assumed that the organizational interaction matrix might be symmetrical (i.e., that cell $C_{ij} = C_{ji}$) and therefore only half the matrix would be needed to characterize organizational interactions.

However, organizational interactions are not necessarily symmetrical. For example, player X may be willing and able to "hear" (factor #2) player Y, but player Y may not be inclined to "hear" player X. Player Y may be highly motivated to talk Player X, but Player X may prefer to write to Player Y. Therefore, in general, the complete matrix is needed to characterize organizational interactions adequately.

We hypothesize that interactional asymmetry can be an important factor in research utilization and innovation acceptance. The process of evaluating the nine interaction factors for each cell of the organizational interaction matrix should help to make asymmetrical relationships evident.

ORGANIZATIONAL COMPONENT OF THE MODEL

Conceptually, each of the nine interaction factors shown in Figure 6 can be quantified for each of the cells of the organizational interaction matrix, Figure 5. Of course, that quantification or evaluation may involve subjective judgement. The details of the quantification process and the numeric nature

of the scaling are arbitrary at this point as long as one can presume there is a monotonically increasing relationship between factor values and facilitation of technology transfer and user acceptance. That is, greater inclination to seek, hear, read, utilize, etc., is assumed to correspond to a greater degree of organizational effectiveness regarding the utilization of innovations.

Given this monotonic relationship, we define the organizational component of our model in equation 1. The organizational component "0" is defined to be the linear weighted sum of the organizational interaction factors.

$$0 = \sum_i \sum_j \sum_k w_{ijk} a_{ijk} \quad (1)$$

w = factor weights

a = organizational interaction factors

i = "player X" index, $1 \leq i \leq 5$

j = "player Y" index, $1 \leq j \leq 5$

k = "factor" index, $1 \leq k \leq 9$

The organizational interaction factors a_{ijk} have been discussed. The weighting factors w_{ijk} are included in order to represent explicitly that not all factors and not all X-Y relationships are equally influential.

INNOVATION FEATURES

In addition to organizational factors, user acceptance of a specific innovation or device obviously will be influenced by the perceived features of the innovation or device itself. These innovation-specific features will be subjectively evaluated by users, and both common sense and the research literature tell us that user acceptance is profoundly affected by this evaluation (Mackie, et.al., 1972). Consequently, our model of innovation acceptance includes a component which reflects specific features of innovations.

The features we believe to be particularly important in the innovation acceptance process include:

1. relative advantage
2. compatibility
3. simplicity
4. observability
5. trialability
6. supportability

Each of these will be briefly discussed in turn. (Some are also discussed in Section Two: Review of the Literature.)

Relative Advantage. Relative advantage is the degree to which an innovation seems to a user better than the idea it supersedes. The greater the relative advantage, the more rapidly an innovation is adopted. This is

not only intuitively clear, it has been demonstrated (Rogers and Shoemaker, 1971).

Compatibility. Compatibility is defined in innovation acceptance theory as the degree to which an innovation is seen by users to be consistent with their existing values, past experience, and needs. Compatibility in the sense that an innovation must be operationally compatible with other systems with which it must work is also of concern. The compatibility of an innovation has been shown to be positively related to its rate of adoption (Rogers and Shoemaker, 1971).

Simplicity. Simplicity is the degree to which an innovation is perceived as relatively easy to understand and use. Complexity has been shown to be negatively related to rate of adoption (Rogers and Shoemaker, 1971). It has been shown that simplicity is a highly desired feature by users of innovative systems in the Navy, although simplicity must be constrained by realistic considerations; if users perceive that a problem has been oversimplified to the point of compromising real-life complexities, relative advantage is sacrificed.

Observability. Observability is the degree to which the results of an innovation are visible to others. The observability of an innovation has been shown to be positively related to its rate of adoption (Rogers and Shoemaker, 1971, p. 168). (This of course assumes that relative advantage, compatibility, and simplicity are viewed favorably.) Observability is likely to be particularly important in acceptance of computer based products about which there is some initial scepticism.

Trialability. Trialability is the degree to which an innovation may be experimented with by users. The trialability of an innovation has been shown to be positively related to its rate of adoption. It should be noted that trialability may involve hands-on experimentation; however, it may also be vicarious. That is, the user may simple visualize how the innovation may be used in his own operating environment by himself or others.

Supportability. User acceptance is behavior which should be sought, not just at some specific moment in time, e.g., at introduction, but over the entire life of the innovation. Consequently, supportability of the innovation is crucial. Innovations which offer relative advantage, compatibility, simplicity, etc. may still, ultimately, experience user rejection if the features of the innovation cannot be maintained in a favorable condition because of design deficiencies, logistical support deficiencies, lack of timely updating, etc.

FEATURE COMPONENT OF THE MODEL

Conceptually, each of the features of innovations discussed above can be quantified. The range and other constraints of this quantification are arbitrary at this point so long as there is a monotonically increasing relationship between the numerical evaluation of a given feature and likely degree of user acceptance.

Given this assumption, the feature component of the model is defined by equation 2:

$$F = \sum_n c_n b_n$$

b = Innovation feature values
c = Feature coefficients
n = Feature index, $1 \leq n \leq 6$ (2)

The feature component "F" is defined to be the weighted linear combination of the innovation feature values. The feature coefficients c_n must be present in order to represent explicitly that the various features of innovations are not necessarily of equal importance.

INNOVATION ACCEPTANCE INDEX

The predictive model of research utilization and innovation acceptance is comprised of the organizational component and the innovation-specific component as expressed in equation 3.

$$A = K_o O + K_f F = K_o \sum_i \sum_j \sum_k w_{ijk} a_{ijk} + K_f \sum_n c_n b_n$$

O = organizational component
F = feature-specific component
 a_{ijk} = organizational interaction factors
 w_{ijk} = factor weights
 b_n = innovation feature values
 c_n = feature coefficients
 K_o, K_f = balance constants (3)

The innovation acceptance index "A" is defined to be the linear weighted sum of the organizational component and the innovation-specific component, each of which was previously described. The constants K_0 and K_F are balance constants to represent explicitly that the organizational component and the feature-specific component do not necessarily have the same impact on research utilization and innovation acceptance. For example, in cases where some features of an innovation are viewed negatively, it is unlikely that organizational variables can insure acceptance, no matter how favorable they may be. Conversely, if the features of an innovation have clear relative advantage over what the user currently employs, it is unlikely that poor organizational factors will necessarily prevent adoption of the innovation. Consequently, the innovation-specific component may be weighted more heavily than the organizational component. However, for many innovations, whose advantages may not be immediately obvious, the organizational factor is very important and can be decisive.

If the assumed monotonic relationships between the hypothesized factors and likely degree of acceptance hold, (i.e., if increasing any one of them increases likely degree of acceptance), and if, as assumed, the factors themselves are not negatively correlated to any practical degree (i.e., if increasing one of them does not decrease another by a substantial amount), then the numerical value of the innovation acceptance index "A" should be strongly correlated with likely degree of user acceptance.

Thus, if these assumptions are for practical purposes valid, the model will predict likely degree of innovation acceptance. The constraints on the

constants, the range of values employed in quantifying the variables, and any subsequent normalization procedures and additive constants can be tailored arbitrarily. For example, the innovation acceptance index "A" can be caused to range between zero and one hundred, to represent predicted degrees of acceptance ranging from the worst likely outcome to be experienced, to the best.

SUMMARY AND CONCLUSION

A predictive model of research utilization and innovation acceptance has been presented which has an organizational component and an innovation-specific component. The model takes account explicitly of variations in relative impact of various organizational factors; player pairings; innovation features; and generic versus specific influence. Asymmetrical relationships among players is considered explicitly.

We believe this model can be useful in generating hypotheses, structuring research, predicting the results of change, and identifying areas where research may have the greatest impact.

SECTION FIVE

INTERPRETATION OF INTERVIEW COMMENTS

IN THE CONTEXT OF THE MODEL

In the previous section we described a predictive model of innovation acceptance with particular reference to factors likely to affect training device utilization. In this section we will attempt to interpret some of the results of our interviews with Navy personnel in the context of the model in order to understand better both the applicability of the model and the meaning of comments made by the interviewees. The comments will be presented as direct quotations, then interpreted in the light of the model. These quotations should not necessarily be considered to represent how things "really are," but they certainly reflect the attitudes and beliefs of some of the people interviewed. Clearly, these attitudes and beliefs are of considerable importance to innovation acceptance.

In accordance with the structure of the model, we will consider comments relating primarily to organizational factors first: then, we will consider comments relating to features of innovations.

ORGANIZATIONAL FACTORS

The comments made to us by the interviewees, have been organized roughly according to the organizational categories identified in the model, namely researcher, funder, developer, builder and user. We will discuss comments relating to each of these categories in turn.

Researcher

"Many of the researchers in this laboratory don't know where their research is going. The most successful people here have been the ones who have been willing to get out and work with other agencies and offices."

Obviously, the researcher who made this comment believes that a high degree of organizational interaction is desirable, and that such interaction is correlated with "success."

"The transfer of R&D to device design is not very good. [Researchers] could have an impact but they need to get over their isolationism."

Another believer in the desirability of enhanced organizational interaction, this member of the funder community believed that the problem is more the result of researchers' reluctance to interact rather than reluctance on the part of other players (funder, developer, builder, user). Quantification of the organizational interaction matrix, Figure 5, would provide the opportunity to see whether other players view researchers in this way also.

"There are difficulties in translating research results into formats that the engineers are used to. R&D people should be more involved in the translating process."

In the context of our model, this comment by a researcher refers to the researcher-developer and the researcher-builder cells of the organizational interaction matrix on factors 6 and 7, "talk innovation information," and "write innovation information."

"There appear to be many innovative devices and new developments sitting around that we don't get to use. Where is the clearinghouse for these innovations?"

As we mentioned in the discussion of the generalized organizational diagram, Figure 3, the research function in the Navy is performed within a variety of organizations in a number of different places. There would indeed appear to be a problem in keeping abreast of developments across the board, as this member of the user community commented.

"The design [of a certain trainer constructed for research purposes] reflected a lack of awareness of how training is being done. Strong rejection followed. You need a hotline among all interested parties."

Another strong endorsement of organizational interaction and an indication of the possible consequences of its absence.

"We're solving problems on line and are way ahead of the researchers."

This comment by an engineer of the "developer" community probably reflects a different criterion of evaluation than the researchers themselves would employ. However, the important thing is the attitude that researchers are lagging behind in terms of something that the engineer judges to be relevant to his needs. Although there is considerable ground for philosophical differences concerning what the objectives of R&D should be, frequently attitudes such as the one reflected in this quotation can result simply from poor communications between the researcher and the developer.

"Most R&D shows up in proposals in such a way as to generate a competitive edge. This may be the fastest way to generate an impact from research."

Thus, it may be the "builder" that facilitates the introduction of innovation. This is likely the result primarily of contractor in-house R&D, and raises interesting questions regarding the relationship between contractor R&D and Navy research efforts. In our model, the upper left hand cell of the organizational interaction matrix, Figure 5, (researcher-researcher) is meant to represent interactions within the research community.

"Navy R&D people should be doing more demonstrations and fewer reports."

This comment by a researcher stems from experiences indicating that informal communications and demonstrations can be more effective than written communications. Whether or not R&D people should write fewer reports, it does seem likely that researchers might be able to communicate more effectively with the other players (funder, developer, builder, user) via other channels. The model is intended to recognize this explicitly.

"When the research people are called in for a problem it is too late to do much good."

Acquisition programs are almost always conducted on an extremely stringent time schedule. However, the scientific approach to problem solving often involves time-consuming empirical research if clearly applicable data do not already exist. If researchers and developers had a more highly interactive relationship, perhaps problems could be anticipated more often, so that needed data could be generated in a timely fashion.

"One thing that limits the use of innovations from research is the need for demonstration that the data apply in the new context".

Sometimes, this problem arises because experimental tasks are chosen which are not relevant to any specific application. Often, the basic scientific objectives can be addressed employing experimental tasks that are operationally relevant. Improved organizational interaction may be a sufficient condition for improving relevance; it surely is a necessary condition.

"The real means of relating research to real world problems is through a continuing dialogue."

As discussed in Section 4, the model is intended to permit representation of a variety of organizational factors and players involved in achieving an effective dialogue.

"There are fundamental differences and viewpoints between users and researchers concerning trainer features necessary to achieve particular training objectives."

We hypothesize that a significant proportion of the differences referred to by this researcher could be alleviated by improved organizational interaction.

Funder

"There should be budgeting provisions for insuring product improvement and necessary changes after a device is first delivered. This should be a cradle-to-grave support program."

We noted frequent expressions like this one from a member of the developer community addressing the need for adequate support of innovations after they are in the field. Largely, this support is dependent on the sponsorship of the funder, and is forthcoming only if the funder is willing and able to "compete" successfully for funds against newer, more urgent--or more "glamorous"--systems.

"There are a whole bunch of formal directives that nobody lives with."

Formal directives, in themselves, do not get things done. Command attention and informal interaction play very important roles in the way things are really done. However, formal directives should support and reflect actual practice, or they can be counter-productive. If, as this developer stated, they don't reflect actual practice, the situation needs close examination by

management.

"[The developer] appears to be caught up in a time schedule. They won't tolerate any delay even if research needs to be done."

Time pressure, indeed, appears to be very great, particularly with training systems that must be in place to support new weapon systems. However, the "funder," as the executive and overall program planner in our "researcher, funder, developer, builder, user" model, needs to employ every management device possible to maximize the availability of resources (time, money) to ensure the systematic and orderly development of training systems. The quotation above by a "user" indicates that he does not feel that an optimum balance has been achieved.

"It is difficult to get the detailers to recognize the importance of leaving Fleet Project Team members in their assignments."

Lack of continuity in Fleet Project Team membership was one of the most frequent comments we received. Management (i.e., OPNAV) should take a close look at this problem, or if they have, they should attempt to communicate convincingly to the Fleet that the present system is optimal. We suspect that, in the context of our model, communication between "funder" and "user" on this issue leaves something to be desired. The FPT member who made the comment above certainly felt that way.

"The responsibility/authority for procurement of [a large combat systems trainer] as a whole is far too diffused. Nobody is looking at the fully integrated system."

We heard a number of comments like this one from a member of the user community to the effect that responsibility/authority for procurement for a

variety of training systems was too diffused. Management control is one sort of communication, a kind of feedback loop that shapes the behavior of various elements of an organization to bring about coherent movement toward overall goals. There is the impression among a number of people we talked to that this sort of management control is insufficient during the development of many training devices.

"The required computer components were not in the supply system. Lack of full support has resulted in degrading the performance of a very good training device. This reflects a management failure; it's a good example of responsibility ending when the device is delivered."

The sort of problem pointed to by this user comment obviously needs attention. Even if everything possible is being done, the perception in the field is sometimes that nothing is being done. This fosters an attitude which certainly does not enhance acceptance.

"QA&R is never called in to the early device acquisition process. We caution that they shouldn't reinvent the wheel, but have never been invited in."

An example of where "X" is willing to talk, but "Y" is unwilling or unable to hear? Or has "Y" been able to obtain the information somewhere else? If so, "X" is uninformed about it, and believes there has been a communications breakdown.

"We must deliver training systems, not devices, if we are to avoid user acceptance problems."

This, of course, is a very important point (made by a member of the developer community), and the Navy management should make a concerted effort to assure that training systems are indeed delivered. In the context of the model, it will require that the delivery of training systems be facilitated by

making the appropriate information and other resources available, and by making it rewarding for the developer to do so.

"Often we don't have adequate numbers of engineers to effectively manage the contractors."

In the context of the model, a resource shortage of the sort pointed out by this member of the "developer's" organization negatively impacts the ability of the "developer" to interact with the "builder," with resulting potential for negative impact on eventual user acceptance.

"Some trainers meet the specifications very well but are poor trainers because the specs were bad. Specifications are often vague in many areas."

This comment by a member of the "user" community was echoed by others we interviewed. We believe the most likely cause for this problem is inadequate front-end analysis and insufficiently supported functional specification. The probable cause of these shortcomings is the time pressure which is pervasive throughout the acquisition cycle of trainers which are intended to support new weapon systems. Compromises made in the early stages of the acquisition cycle are particularly likely to have substantial negative consequences in eventual training effectiveness and user acceptance.

"There should be an on-line reporting system that permits users to get directly back to the procurement system."

This comment by a "funder" suggests that an interactional asymmetry exists in the developer-user relationship. However, improved opportunities for user feedback to the developer are not likely unless the added effort required to provide them is perceived by the developer to be sufficiently rewarding. Often, the immediate payoff to the developer is in solving

problems with current acquisition projects, rather than projects which are perceived to be "completed." Positive reinforcement of "developer's" increased attention to "user" after a trainer has been delivered is likely to be provided effectively only by top management--the "funder." Otherwise, it is easy to understand that the developer will be preoccupied with problems of the system he is currently developing, while the user is preoccupied with problems of the already-developed system which he has to employ.

"[This developer] needs to talk more within itself about the state of the art and what we're doing."

Our model provides for representation of interactions within organizational elements, along the diagonal of the organizational interaction matrix, Figure 5. For example, this interviewee was commenting on interactions that would be represented in the "developer-developer" cell.

"System sponsors say 'get the hardware out to the Fleet and they will figure out how to use it.'"

Although the Navy's traditional "can do" attitude does sometimes foster this sort of thinking, it is, of course, not consistent with an effective approach to the introduction of training innovations and training systems implementation. Unfortunately, we believe this comment, made by member of the "developer" community, all too often represents actual practice quite accurately.

"It is practically never possible to do the required front-end analysis. It has to be done some five years before the training device will exist to meet budgetary cycle constraints. The contract should be let four years before the aircraft flies."

This is an extremely difficult problem to solve, as this "developer's" comment suggests, but clearly it can have a negative impact on eventual user

acceptance. Perhaps one thing that can be done to ameliorate the acceptance situation is to make clear to the user community what the problem is and how difficult it is to solve.

"We have hundreds of millions of dollars of trainers in the field that were requested by users who were gone by the time they were delivered. The device ends up with no [user] support."

Military personnel turnover is a fact of life, as this developer's comment indicates. However, the negative consequences of this turnover can be reduced to a minimum if the training system funder and developer have a continuing commitment to fielded systems, and ensure that a dialogue is established with new users, so they can at least appreciate, if not totally endorse, the reason-for-being of trainers they "inherit."

Developer

"[This SYSCOM] needs to get more involved in how programs in 6.1, 6.2 and 6.3 [i.e., research programs] might help them downstream".

This comment reflect a felt need on the part of one member of a "developer" organization for closer interaction with researchers.

"A successful project manager will have a strong communication link with the chairman of the Fleet Project Team."

Obviously, this developer believes in the importance of interaction with the user.

"FASO [Fleet Aviation Specialized Operational Training Group] has the responsibility to track configuration changes and let the NTEC [Naval Training Equipment Center] Project Engineer know what changes need to be made. There does not not seem to be a solid method for ensuring that this will happen. We have a 4 to 5-year accumulation of problems identified by QA&R [Quality Assurance and Revalidation] that have not been fixed".

It is evident that this sort of perceived situation is likely to have a negative impact on user attitudes; it certainly had on the user who made this comment. If there is a good reason for the developer's inability to support trainers in the field, those reasons should be communicated effectively to the users to head off the formation of negative attitudes.

"[This SYSCOM] does not have an effective tie with what the government labs are doing. It is doubtful whether we influence what goes on in research codes."

In the context of our model, this opinion reflects a deficient researcher-developer interaction.

"MC's [Military Characteristics--specifications from which trainer procurement contracts are prepared] are kind of ginned up to meet the Fleet's wish list. There is not enough front-end analysis. There does not seem to be a clear cut criterion for how much front end analysis will be done. [The developer] often skips the process altogether and jumps right into development."

We don't know how accurate this comment by a training technology researcher is, but from our interviews it does seem that time pressure makes it expedient to move into development as quickly as possible, and the atmosphere certainly lends itself to glossing over systematic front-end analyses. However, to the extent that such compromises of systematic development are made, greater risk is taken regarding actual training effectiveness and eventual user acceptance.

"[The developer's] engineers evaluate their own job! Acceptance testing should be done by someone else."

Actually, the developer's engineers may be the best person to judge whether the product has met the specification. However, as mentioned elsewhere, the specification may not necessarily be an accurate translation of

what the training objectives are. Therefore, it would seem desirable that in addition to acceptance testing against the contractual specification, there should be some sort of "operational test and evaluation" and/or training capabilities testing performed. This would probably not only lead to a better product, but serve as well to allay the doubts of people in the user community like the one who made the comments above. CNET's QA&R program is doing a review of devices just after contractual acceptance in conjunction with the Fleet Project Team. This may serve to answer the need, but the practice is not yet firmly established Navy-wide.

"The front end analyst must put in features that he knows are desirable and then sell them to the user."

We are sympathetic with this point of view expressed by a member of the "developer's" community; if the training specialist has done his homework and has interacted closely with the user, it is likely he will be able to identify features that are desirable in terms of meeting training objectives. However, when innovations are involved, he still may have to "sell" them to the user. This is a role that is not comfortable for many developer personnel. In any case the whole process implies a high degree of organizational interaction between the developer and the user.

"Training course documentation is always the weakest part of the package when it is delivered."

"Documentation in how to use a trainer is never up to snuff."

"There is no instruction on how to instruct using training devices."

These comments by members of the developer community have been echoed by others. The organizational reward system is much more likely to focus on the hardware parts of the training product in reinforcing developer behavior.

However, particularly with the ever-increasing sophistication of trainers , it is not reasonable to expect the user to figure out for himself how best to use a trainer. Members of the developer community recognize this (as the above quotations demonstrate), but they cannot change the organizational system of reward and punishment by themselves; it will take interaction among the various players, and particularly the support of top management. (i.e., the funder).

We received many comments regarding methods of training system development. Several pertinent quotations are presented below, followed by our own commentary.

"The trainer contract may call for a front-end analysis--this is too late!"

"DOD instructions now exist that require front-end analysis. This doesn't ensure that it will always be done because of time and budget constraints, but usually it is."

"You often have to fight for the front-end analysis. The educational specialists and the engineer really look for different things, and both are essential as a complimentary team."

"[The developer] should do much more front-end analyses of objectives/needed media types."

"Front-end analysis is being done after the fact."

"[This developer] sees a need for front-end analysis but feels ISD [Instructional Systems Development] has become a rigid step-by-step process that costs a lot of dollars to produce trivial outputs. ISD should focus on the areas of innovation."

"The front-end analysts are not of uniform quality. The engineers are usually quite good but do not know how to do the front-end analysis or supervise contractors who perform it."

"We are being selective in the amount of ISD but usually carry it from task analysis through media selection."

"Trainers are developed prior to identifying tasks that have to be taught. The training objectives are very general."

"We have always had OFT's (historically); therefore, it is very hard to reorient user thinking toward part-task trainers. ISD has made a significant change in this respect but it is uncertain as to how long the ISD impact will last."

These comments by researchers, developers, and users indicate a problem area. Based on the interviews, we hypothesize that the application of potentially effective methods of training system development (e.g., front-end analysis, selected aspects of instructional systems development (ISD)) is beset by three principal difficulties:

1. Difficulty of gaining recognition that the process requires specialized knowledge. Many of the most promising methods of training system design have grown out of basic research in management and behavioral sciences. A substantial body of specialized knowledge has been developed in areas which often appear to the non-specialist as requiring nothing more than "common sense" or "intuition" to deal with effectively. Thus, "hardware-oriented" managers often do not appreciate the contribution that is potentially available. Certainly, common sense is required in large doses. But intuition has been shown very often to be a poor substitute for specialized knowledge of human behavior when attempting to build training systems that will shape human behavior effectively.
2. Bad impressions created by some training specialists. Some training specialists have tried to apply methods of instructional systems development without really coming to understand the subject matter area of the training system, and the real world constraints on it, sufficiently. A slavish devotion to the principles of ISD without a genuine attempt to understand either the subject matter area or the problems of the training systems manager and user is virtually certain to lead to an inappropriate product and to alienation of the other players.
3. Ever-present time/money pressure.

We believe a systems approach to training development is essential. However, the systems approach is, in some part, innovative, and the acceptance and endorsement of these innovations by the "funder" and "developer" is essential for their continued effective use. This means that educational specialists and others who wish to promote development of innovative training systems must

engage in an optimum interaction with the funder and the "traditional" or "hardware" side of the developer's house.

Builder

"In some cases the contractor is a leader, if he really knows his stuff; in others he is a follower - responds to everybody's inputs."

"Lots of civilian contractors build trainers that won't do many of the things they should do because they really don't understand how the [operational] system works."

"The contractor often has no knowledge about the subject matter of the trainer. He often doesn't understand critical details [in stimulus presentation]."

It was frequently commented to us, as in these remarks from the developer and user communities, that contractors were the source of considerable variability in the quality of training systems. It appears that the procurement process cannot guarantee selection of a contractor who will produce a satisfactory product. Sometimes, the competitive process is such that the developer must accept a contractor as "winner" of the competition even though he doubts the contractor can totally live up to the claims of his proposal. In other instances, the same contractor who has performed well on past projects may perform poorly; or vice versa. It appears to us that although some variability is unavoidable, a strong interaction between "developer" and "builder" will go far to make the best of the situation. The above quotes also suggest that a strong interaction between "builder" and "user" is desirable.

"The source of most innovative technology would appear to be the contractor's response to the military characteristics/device specifications."

It is interesting that we frequently received comments like this one from a "developer" to the effect that training device innovation is more likely to arise from the private sector than from the military laboratory or research agencies. It is understandable, and in fact a benefit of the free enterprise system, that innovation is brought forth by the contractor to gain a competitive edge. But the perceived leadership of the private sector in innovation causes some members of the developer community to question the value of governmental research activities.

We did not have the opportunity to interview any persons from the private sector "builder" community. Consequently, we cannot offer any insight directly from the "builder's" point of view. It would be desirable to expand the data base to include those points of view.

User

"User non-acceptance almost always reflects a lack of proper introduction of the device to the user."

Most researchers who have studied innovation acceptance would agree with the researcher who made this comment that proper introduction of innovations is a necessary condition for acceptance in most cases.

"The FPT [Fleet Project Team] is the key element in the 'ownership' issue. The qualifications of FPT members represent an uncertainty, and there is no clear mechanism for the FPT members' peers to know what is being done on their behalf."

This perceptive member of the "developer's" community has pointed to one of the FPT's important roles. The Fleet Project Team members act as "linkers," which are defined by Jolly (1980) as "individuals in the receiving

organization who link or couple persons in their organizations to outside ideas, concepts, and new devices. Linkers are persons who operate in the same organization or allied organizations (with social overlap) as those persons who will actually use the new technology. Linkers are sometimes called gate keepers, opinion leaders, information sources, or early knowers of knowledge. Linkers are not necessarily superior technical persons, rather they are "knowledgeable sources." A necessary part of the linker role is effective communication with other persons in the user organization. Consequently, the comment above regarding "no clear mechanism for the FPT members' peers to know what is being done," which we believe to be generally true, is particularly distressing. This weakness would be represented in our model in the "user-user" cell of the organizational interaction matrix, Figure 5, by poor internal interactions as represented by the various factors.

"The sense of ownership is important in relation to user acceptance; who developed the idea is important".

This comment by a member of the developer community regarding user acceptance shows a salutary awareness of fundamental principles of innovation acceptance. Whether these principles are able to be put into practice effectively depends on positive organizational interaction across the board.

"The users must see immediate benefits to themselves."

Immediate benefit is crucial, as this "funder" has pointed out, and it involves both the organizational milieu and specific features of the innovation. Fleet personnel whom we interviewed during this project were for the most part highly dedicated to meeting their operational commitments, which often impose substantial workloads. Most fleet users have little time or inclination to adopt innovations that do not seem to contribute directly and immediately to meeting these commitments.

"User resistance is high if the trainer was 1) 'not invented here and' 2) 'does not train in the way I was trained in the past.' User personnel are not typically qualified to judge the potential training effectiveness of the trainer."

The "not invented here" syndrome is recognized by this "developer," and is well known to those who study innovation acceptance. The persistence of old, familiar methods is a backbone of resistance to innovation. Regarding the qualifications of users to judge potential training effectiveness, many users suspect that some members of the developer community are not qualified to judge the potential training effectiveness of various innovations either. The developer must attain credibility in the eyes of the user to be able to promote innovations in the most favorable way. This factor is represented in the model.

"We [the fleet] need to make inputs on threats and required fidelity. CNET should then take charge without further inputs unless there are trade-off decisions about available dollars. The fleet should be involved in prioritizing; we don't presently do this."

Developer and user agree that subject matter expertise is a necessary input--although the issue of who is able to judge "required" fidelity is a delicate one. Regarding prioritizing, we frequently got comments like this from fleet users that it was desireable and appropriate for them to make such inputs. In some cases, they have the opportunity to do so; in others, they feel their wishes have been ignored.

"We train primarily at sea because we do not have suitable trainers."

This comment by a fleet training officer implicitly suggests that "suitable trainers" would be used to replace at-sea training hours. We believe trainers would be used in this officer's warfare area because post-exercise reconstruction for the purpose of training feedback is extremely

time-consuming and costly to obtain from at-sea exercises. Acceptance is greatly facilitated when there is a strong felt need. The definition of "suitable" trainers requires interaction between developer and user. Trainers are being developed in this area, but they will not be delivered soon--a fact that has generated considerable user criticism.

"There is a big difference between what the school needs and what they say they want. School personnel are not knowledgeable about what's available."

As this member of "developer" organization points out, fleet personnel are not generally training technology experts. However, since school personnel are performing the day-to-day tasks of training in the Navy, is to be expected that they will form very definite opinions regarding their needs. In the absence of a strong interaction between developer and user, the user may "invent" a different approach to a problem than the developer, which is bound to lead to substantial acceptance problems.

"The Surface Warfare Trainer Group is kind of replacing the Fleet Project Team during the planning phase, with the FPT playing the more important role during test and evaluation. The SWTG mostly involves tweaking of already laid plans. However, their evaluative inputs are very valuable, and their sense of involvement is very important."

We hypothesize that the Surface Warfare Trainer Group, the Submarine Trainer/Training Working Group, and the Fleet Project Teams are extremely important in establishing organizational interactions in the Navy which are favorable to innovation acceptance.

"The computer graphics in the amusement arcades is often better than ours. Our systems are antiquated. You know the technology is out there--but we won't see it for years."

The rapidly advancing technology of the electronics industry has spawned so many new developments in consumer-oriented electronics at such a rapid

pace, that users of military technology (like the one who made the comment above) find it especially difficult to accept the lengthy training systems acquisition cycle. There are no doubt many good reasons why that cycle is lengthy--and perhaps some not-so-good reasons. Greater interaction between funders, developers, and users could help the users to be more accepting of the time necessary to develop new military systems. This could be useful in facilitating acceptance of currently available trainers while new ones are being developed.

"FPT members don't know enough about the new equipment or the theory of operations to state what the trainer should really do [in the case of prime systems in the very early stages of development]. They ought to go to the lab which is developing the prime hardware system."

This is a request by a user for greater interaction with the developers of new weapon systems for which trainers must be built. It is another example of an attitude which we encountered fairly often, namely, the desire of Fleet Project Team members to have a stronger interaction with the other players.

"We sometimes get invited but can't go to the meetings for the lack of dollars or time--or else we can't send the 'right' person."

"I could easily spend 90% of my time meeting FPT responsibilities."

"Sometimes only the east coast gets the FPT members to a meeting because their travel costs are usually less [since they are closer to NTEC.]"

"Travel dollar problems are commonplace."

"We have about two weeks to review and prepare comments on very complex technical documentation. The requirements can come at very inopportune times."

"There is never enough time for an FPT member to do the job right."

"As Chairman of an FPT, I am on the phone three hours a day. Some commands cannot afford this kind of time--it just comes out of our hide."

"I have one officer on the road two weeks out of four and he still cannot do all of the things that the FPT Manual requires."

"I can't possibly evaluate all the specs they send me, especially in the 10-day period I usually have."

"It is very difficult for fleet personnel to make the inputs they should to new training devices because of lack of time and dollars."

These comments by FPT members (users) speak for themselves. Fleet Project Team membership is always a collateral duty, and OPNAV Instruction 1551.7b states that "travel and per diem funds required for FPT members shall be provided by the members' respective duty stations." Conscientious Fleet Project Team members frequently complained of the constraints of time and funds.

"There is a major problem with nonavailability of subject matter experts including the FPT members. We don't really understand [new] systems that well."

"The required subject matter expertise within the FPT may be very thin. Getting people who are really experienced with advanced systems is very difficult--you can't get them off the ships."

"You can't expect the FPT to solve any problems for you--they vary too much in quality."

"Fleet Project Team continuity is a problem. Their impact varies greatly with particular personalities."

These developer and user comments point to two problems. Naturally, there is a problem getting top-notch people in any organization. However, there is an additional problem for the Fleet Project Team: trainer development is often to support a weapons system acquisition which itself is in an early stage and may incorporate innovative features that are not very well defined. Consequently, it is difficult for the FPT members to act effectively in the role of subject matter experts.

"We have been called in after the specifications were written and the contracting accomplished every time."

"Quite often the FPT was brought in in an acceptance role after it's too late. The [developer-laboratory] loop will design some specifications without any FPT input whatever. They are very protective of their systems. Laboratory people are happily isolated from the fleet users."

Sometimes, Fleet Project Team members like the ones who made the comments above feel their views aren't all that welcome, although usually they seem interested in receiving information from other players. We believe this represents an example of interactional asymmetry. As mentioned before, the model is able to accomodate and represent this sort of relationship.

"[The Quality Assurance and Revalidation team] tries to get the users, custodians, and operators around the table--seems to be the only time they talk to each other."

This comment by a member of the QA&R team suggests, not surprisingly, that the user community, like the other organizational elements of the system, has problems with internal interaction. Internal interactions are represented on the diagonal of the organizational interaction matrix, Figure 5.

FEATURES

Up to this point, we have discussed a sampling of the comments made during our interviews that relate primarily to organizational factors, which comprise the first major element of the model of innovation acceptance described in Section Four. Now, we wish to focus attention on some comments which were made primarily in regard to training device features. The feature-specific aspect of acceptance comprises the second major element of the model.

"Low-cost cockpit trainers tend to fall into the non-accepted category. There has to be a lot of fleet understanding. The problem is that even if you get it at the outset, the next batch of users may not be accepting."

The high rate of personnel turnover in the Navy poses special problems for innovation acceptance, as this developer's comment suggests. The change advocate (if he can be clearly identified!) is likely to have to maintain a continuing involvement after innovation introduction to facilitate acceptance, rather than to rely on "corporate memory" in an organization with such a high turnover rate.

"There is user resistance to trainers which, because of their complexity of operation, make the users feel like a dolt."

"[The developer's] recommendations on the specifications are critical but they tend to make the device too sophisticated. We don't want training devices that require training courses to learn how to operate them."

"Users don't use the whole device--often don't understand its full capabilities, although sometimes what they don't use is not required by their curriculum."

"One elaborate trainer is having acceptance problems because it requires four instructors. What role did the FPT play in permitting this to happen?"

"We buy a lot of trainers with features that are never understood and never get used."

"You can design an instructor station with too many provisions for feedback. We don't need buckets of statistics."

These developer and user comments address the issues discussed in Section Four under the heading "Simplicity." Often, developers and builders put less emphasis on simplicity than users. This sometimes leads to significant user acceptance problems.

"The end user is the guy who knows the least about what trainer capabilities are required to meet the training need."

"Only the users should make certain kinds of tradeoffs--we [the users] should decide what to give up vs. what is critical."

This pair of comments, from a member of the developer community and a member of the user community, respectively, shows an interesting disparity.

Organizational interaction can't completely resolve this sort of difference, but without a reasonable degree of interaction, the parties can become very polarized, indeed, with a very negative impact on user acceptance of the developer's products.

"There are [developer's] engineers who are strongly opposed to trainer provisions for performance evaluation."

"The users don't know how to use performance measurement systems."

"Instructors may be resistant to trainer features such as performance measurement systems because the data show what a poor job they're doing."

"Performance scoring devices may not be accepted as well as 'instant replay' devices."

"Fleet personnel are resistant to automated performance evaluation systems."

These funder, developer and user comments highlight an area where acceptance problems are particularly likely to be experienced. Automatic performance measurement is sensitive on at least two counts: 1) the validity of the methodology employed to generate specific performance measures is often open to question; and 2) the performance measures are often threatening to the instructor and/or the student. Mutual understanding of these considerations among the concerned parties seems to us a necessary condition to paving the way for much needed innovation in performance assessment.

"Trainer maintenance is a major factor in user acceptance problems."

"There is inadequate planning for life-cycle support of trainers. NTEC can become the inheritor of devices that other people buy with no appropriate ILS [Integrated Logistics System], technical documentation, etc."

"Hardware and software changes to trainers come extremely late. The only thing some of our trainers are good for is voice procedures."

"I was scheduled for 100 part-task training hours during my last tour and actually got 15 [because of trainer maintenance problems]."

"Sometimes the WST [Weapons Systems Trainer] goes down after you are one-and-a-half hours into a problem. There is no way to recover where you were. Thus we lose qualification time. Not many of our crews look forward to using the trainers because of this."

"OPNAV, NAVAIR, NTEC, and the Fleet work closely together in the early stages of trainer development but this does not carry over into the life of the trainer."

"Acceptance problems may develop over time because of corporate memory loss on how to fully operate the trainer."

"Trainers notoriously degrade with operational age."

"If a trainer is not maintainable it does not matter how good the design is in other respects."

As these funder, developer, and user comments suggest, user acceptance is not something which, once achieved, is assured thenceforth. It is a condition which requires careful attention to attain initially, but it also requires continued attention. Truly, achieving user acceptance of complex technical systems is a "cradle-to-grave" proposition.

SECTION SIX

CONCLUSIONS AND RECOMMENDATIONS

The Navy is increasingly dependent upon the use of complex training devices for the achievement and maintenance of operational readiness. As the scope of training device missions has increased, so has the cost of procurement, maintenance, and utilization, placing increased importance on effective use. However, previous research has shown that there are often important mismatches between the characteristics desired in training devices by their users and various features that are actually designed into them.

There is considerable doubt that the Navy's research effort related to training innovations is achieving its full potential impact. There are substantial differences of opinion among individuals in a number of Navy organizations relating to the most cost-effective design of training devices and how best to incorporate innovative developments into those designs. This results in problems of acceptance on the part of both individuals and Navy organizations, whether they are concerned with the design, development, or use of training devices. Of course, acceptance problems at the point of the user are likely to be the most consequential.

In an effort to move toward a solution to these problems, research was conducted to develop a model of factors influencing user acceptance. The model reflected reviews of the literature on innovation acceptance, technology transfer, and organizational development; review of official directives and

instructions bearing on training device development, acquisition, and use; and interviews with personnel representing most of the organizational "players" in the trainer development, acquisition, and use process.

It was concluded from the literature on innovation acceptance that:

1. There is a wealth of information concerning variables that are likely to influence the acceptance of training innovations, the most important of which include relative advantage, compatibility, simplicity, observability, trialability, and supportability. An extended discussion of this information is presented in this report.
2. No predictive model has been developed that represents both organizational factors and feature-specific factors as they influence the acceptance of innovations of any kind.

With respect to the literature on technology transfer in the Navy, it was concluded that:

1. Many important factors have been identified and incorporated into a useful model of technology transfer.
2. This model was not simple enough for our purpose in one respect, namely, that some of the factors identified were not represented in a form that would facilitate quantifying or scaling them;
3. In another respect, the model was not complex enough, in that it did not explicitly recognize that a variety of players may be involved in the development, acquisition, and use of innovations, as well as the interactions and feedback loops that may (or should) exist among them;
4. However, the technology transfer model was useful in identifying a number of important processes related to the organizational component of the model we developed.

With respect to the organizational development literature, it was concluded that:

1. Some recent efforts to relate general systems theory to organizational development were pertinent to the project objectives, particularly in respect to the emphasis on feedback loops within organizations;

2. However, no model was found that provided an adequate conceptual basis for identifying, quantifying, and predicting the effects of changes in feedback loops within an organization, such as the Navy's, which involves development, acquisition and user suborganizations.

It was concluded from a review of official Navy directives and instructions pertinent to training device development, acquisition, and use that:

1. It is difficult to obtain a coherent, integrated picture of the overall training device acquisition process solely from the directives and instructions;
2. The official directives and instructions represent an important adjunct to other sources of information in that they prescribe how things are supposed to be done;
3. Not all of the directives are adhered to in actual practice.

The conduct of a substantial number of interviews with personnel involved in most aspects of training system research, development, procurement, management, and use led to the conclusions that:

1. Opinions regarding what is right and what is wrong in the training device acquisition process are very strong, and there has been a recent history of well accepted and poorly accepted devices. In the words of one respondent, "almost no one is neutral about training devices."
2. The interview results revealed a highly complex training device acquisition "organization"; in fact, organizational makeup varies widely with the type of device being procured.
3. Very different points of view were expressed by members of the researcher, funder, developer, and user communities. Each community appeared governed by its own perspective, while holding attitudes toward the other communities ranging from sympathetic to antagonistic. We hypothesize that many problems of innovation acceptance are caused by the present limited interactions and feedback loops among these communities.

The development of a predictive model of innovation acceptance led to the conclusions that:

1. The model should have two major components: a component intended to reflect organizational factors, and a component intended to reflect specific features of innovations;
2. The model should permit explicit representation of interactions among all of the numerous organizations that are involved. We hypothesize that the categories of researcher, funder, developer, builder, and user are sufficient;
3. The model should permit representation of interactions and feedback loops between organizational elements on a number of relatively simple factors designed to permit quantification, by the use of survey techniques and psychometric methods. Nine organizational interaction factors were presented, which were hypothesized to be sufficient;
4. Six features of innovative devices were identified which are hypothesized to be particularly important in the innovation acceptance process, and which were included in the feature-specific component of the model;
5. The model should be comprised of a weighted linear combination of the factors, at least in this first approximation, since available data do not support proposing a higher-order (non-linear) model.
6. The model has been found to be useful in structuring thinking about problems of innovation acceptance. It is hypothesized that it will be useful in identifying organizational processes that might benefit from change, and in identifying areas where future research on the acceptance process may have the greatest impact;
6. Efforts should be made to quantify at least some aspects of the model, to assess its utility and to attempt to produce results which may be applied directly to solve or reduce some of the practical problems of innovation acceptance identified during this study.

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APPENDIX A

OFFICIAL DIRECTIVES AND INSTRUCTIONS

There are many official directives and instructions bearing on the training system acquisition process. The titles of those we have reviewed are listed below. They are listed by issuing agency.

CNET

ltr N-5, Test and evaluation procedures for training devices, 6 Nov 1979.

Guidelines N-945, Submarine Trainer Working Group, 26 Nov 1980.

ltr N-945, Draft SECNAV/OPNAV Instructions on Selection of Training Equipment; comments concerning, 15 Apr 1981.

INST 1500.9, Participation by the Naval Education and Training Command in the preparation and implementation of Navy Training Plans, 26 June 1974

INST 1551.5A, Training Situation Analyses (TSA); procedures for conducting, 3 Jan 1978.

INST 3920.1B, Research, Development, Test and Evaluation Program of the Naval Education and Training Command, 26 Aug 1981.

INST 5450.8 (NAVMAT INST 5450.28), Additional duty functions of the Commanding Officer, NAVTRAEEQUIPCEN, Orlando, Florida, to CHNAVMAT and relationships between NAVTRAEEQUIPCEN and Systems Commanders, Project Managers and others, 14 Dec 1972.

INST 7000.2A, Procedures and Responsibilities for the development of the Program Objective Memorandum (POM) documentation for the CNET Training Device program, 22 June 1979.

INST 7000.2B, Policy, procedures, and responsibilities for the planning and resource requirement identification for surface and subsurface training devices, (draft).

MEMO N-5, Test and Evaluation of Training Devices, 10 Feb 1978.

NAVCOMPT

Memo NCB 521, Requirement for budgeting procurement of first item training devices in RDT&N, 14 Dec 1977.

NAVMAT

INST 1500.12, Technical Training Equipment Acquisition Requirements, 6 Apr 1981.

INST 4720.1, Approval of systems and equipments for service use (ASU), 13 Dec 1974.

INST 5450.28 (CNET INST 5450.8), Additional duty functions of the Commanding Officer, NAVTRAEEQUIPCEN, Orlando, Florida, to CHNAVMAT and relationships between NAVTRAEEQUIPCEN and Systems Commanders, Project Managers and others, 14 Dec 1972.

NAVSEA

INSTR 1543.1A, Manpower, Personnel, and Training Support for NAVSEA--Cognizant Ship, System, Equipment, and Non-hardware Developments.

NAVTRAEEQUIPCEN

ltr N-8/121, Test and Evaluation procedures for training devices (Draft CNET INSTRUCTION 3960. "Test and Evaluation Procedures for RDT&E Training Device Development"), 28 Feb 1980.

INST 1551.7B, Fleet participation in development acquisition, and acceptance of major training devices, 18 Jun 1974.

INST 3900.10C, The Naval Training Equipment Center planning and programming system; establishment of, 29 Aug 1977.

INST 3910.4A, Functional Statement, Functional Description, Mini-Military Characteristics, and Detail Military Characteristics; instructions and responsibilities for, 18 Feb 1977.

OPNAV

Memo 901/582126, Programming Guidance for the Acquisition of Training Devices, 14 March 1978.

ltr 992F2/640753, Conference on Early Identification of New Systems, Equipment, and Other Developments Generating Training Requirements; reports of, 29 Mar 1976.

INST 1500.8H, Preparation and implementation of Navy Training Plans (NTPs) in support of hardware and non-hardware oriented developments, 3 Jul 1975.

INST 1551.7B, Fleet participation in development, acquisition, and acceptance of major training devices, 22 Apr 1977.

INST 10171.5, Certification of Major Aviation Training Devices, 5 Sep 1978.

MEMO 987/140521, Independent Evaluation of Training Devices, 30 Dec 1977.

MEMO 991B/644005, "Operational" Test and Evaluation of Training Devices,
10 Jan 1978.

MEMO 39C/18, Evaluation of Training Devices, 13 Jan 1978.

Guide, Management of Manpower, Personnel and Training Research,
Development, Studies, and Surveys, (draft) 3 June 1981.

ltr 29P/384170, Submarine Training/Trainer Working Group, 16 June 1982.

SECRETARY OF THE NAVY

INST 9089.1, Selection of Trainers/Training Devices, 9 June 1980.

OTHER

Audit Report I400058, Servicewide Audit of the Aircraft Flight Simulator
Program, 4 Jan 1980.

APPENDIX B

TRIPS AND INTERVIEWS CONDUCTED DURING THE PROJECT

An attempt was made to conduct personal interviews with representatives of all Navy organizations involved in the training device acquisition and use processes. All major platforms (air, surface, submarine) were represented and a wide variety of training devices were used as a focus for discussion. The locations, offices, and training devices included in the survey are listed below. At least one Fleet Project Team member was interviewed for each of the training devices listed.

ORLANDO

- o Air Planner, NTEC Plans and Programs Group
- o NTEC Aviation/EW Analysis and Design
- o Training Analysis and Evaluation Group
- o Sea Planner, NTEC Plans and Programs Group
- o Director, Research Department, NTEC
- o Human Factors Laboratory, NTEC
- o Advanced Simulation Concepts Laboratory, NTEC

PENSACOLA

- o Assistant Chief of Staff, Training Systems Management, CNET
- o Surface Combat Systems Devices, CNET
- o Quality Assurance and Revalidation, CNET

WASHINGTON, D.C.

- o Director, Weapons Training Division, NAVAIRSYSCOM
- o Psychologist, Weapons Training Division, NAVAIRSYSCOM
- o Office of the Deputy Undersecretary of the Navy (Research and Advanced Technology)
- o Office of the Deputy Chief of Naval Operations, Aviation Manpower and Training Division
- o Naval Sea Systems Command, Submarine Combat Systems Project Office
- o Office of the Deputy Chief of Naval Operations, Submarine Manpower and Training Requirements Division
- o Office of the Deputy Chief of Naval Operations (Manpower, Personnel and Training)

RVAW-110, NAS MIRAMAR

- o 15F8A E-2C Tactics Part Task Trainer

VF-124, NAS MIRAMAR

- o 2F95 F-14A Operational Flight Trainer
- o 15C9A F-14A Mission Trainer
- o 2F112 F-14A Weapons Systems Trainer

FLEET ASW TRAINING CENTER, PACIFIC

- o 16H3 Navy Tactical Game-Based Training System
- o 14A12 Surface ASW Trainer
- o 20A66 ASW Tactical Team Trainer
- o 14E37 SQR-17 Team Training Simulator
- o 14E38 SQR-18 Team Training Simulator
- o 14E35 SQQ-89 Acoustic Operator Trainer
- o 14E31B SQS-56 Basic Sonar Operator Trainer

FLEET COMBAT TRAINING CENTER, PACIFIC

- o 20F16 Tactical Action Officer Trainer
- o 7B4 OUTBOARD Trainer

COMMANDER, ASW WINGS, PACIFIC

- o 14D1 ASW Basic Operator Trainer
- o 14B49 S-3A Acoustic Sensor Operator Trainer
- o 2F92A S-3A Weapon Systems Trainer
- o 14E10 SH-3 Sonar Operator Trainer
- o 2F64C SH-3 Weapons Systems Trainer
- o DASTS Acoustic Training Stimulator

HSL-31 and FASO, NAS NORTH ISLAND

o	2F106	SH-2F	Weapons Systems Trainer
o	2F135	SH-60B	Operational Flight Trainer
o	2F117B	CH-46E	Operational Flight Trainer

VS-41, NAS NORTH ISLAND

o	14B49	S-3A	Acoustic Sensor Operator Trainer
o	14B50	S-3A	Part Task Trainer
o	2F92A	S-3A	Weapon Systems Trainer

In addition to the Fleet Project Team members for the above devices, we interviewed the manager and field inspectors of CNET's Quality Assurance and Revalidation West-coast office regarding their program of training device inspection and their interfaces with other players involved in trainer development, use, maintenance, and continuing support. We also interviewed the enlisted training officer, Fleet ASW Training Center Pacific; ASW Training Officer, SURFPAC; Commanding Officer, SUBTRAFAC; Assistant Chief of Staff for Training, SUBGRU5; and 3 persons from ASWINGSPAC and ASW Squadron VS-33.

Finally, we interviewed Dr. Chuck Jorgenson, ARI Field Unit, Fort Bliss, who gave generously of his time so that we might better understand the training system acquisition process employed in the Army. Dr. Dan Fulgham of Technology, Inc., San Antonio, Texas graciously provided us with an overview of U.S. Air Force training acquisition processes.

APPENDIX C

EVENTS AND DOCUMENTS RELATING TO FIRST ARTICLE TRAINING DEVICE DEVELOPMENT

There is a great deal of variability in training device development depending on the specific trainer involved. Events and documentation vary greatly depending on trainer sponsor, trainer development agency, and on the specific issues of each unique development. Furthermore, directives and instructions which impact on the first article training device development process are in a state of flux, so that the procedures followed in the documentation required "in principle" are constantly changing. For this reason, it is difficult to provide a generalized overview of how the development process works now.

An approach which may prove useful in understanding the components of the process is to describe a systematic sequence of events and documents for first article training device development which has been recommended for implementation (Nutter and Terrell, 1982). This sequence was developed by the Training Analysis and Evaluation Group at the request of the Chief of Naval Education and Training. We cannot judge whether this is the optimal management scheme for training device development, but it does represent a well thought out approach that appears to be sound and systematic. Furthermore, most activities which currently are engaged in a trainer development can be understood within the context of the TAEG management system, although it must be understood that specific developments go through development steps which are analogous to a selected subset of the TAEG model.

The TAEG management model is represented schematically in Figure A-1, which is from Nutter and Terrell, 1982. We will provide a brief description of each of the elements of this model which is paraphrased from Nutter and Terrell's more detailed descriptions. Although we have made every effort not to distort those authors' intentions in providing this abridged discussion, we recommend highly that the reader study the original source to ensure complete understanding.

Each event and each document is described in subsequent paragraphs. The titles of the events and documents correspond to those used in the Figure where appropriate specific approval or review functions are indicated; most documents are described in general functional terms and their specific format and content is still in development.

Event 1 Activity. Training Device Requirements are formally documented by the Navy Training Plan and the Development Plans of major weapons systems. In addition, any fleet activity or Navy command may identify a training requirement and submit it to the appropriate sponsor in the form of a documented Training Requirement Statement (TRS) via the chain of command.

Document 1.1 Training Requirement Statement TRS). The TRS is a proposed document modeled after the Mission Element Need Statement (MENS). Training Requirement Statements are concise statements of current or anticipated training deficiencies or needs that have a high perceived probability of solution with the use of some type of training aid or device.

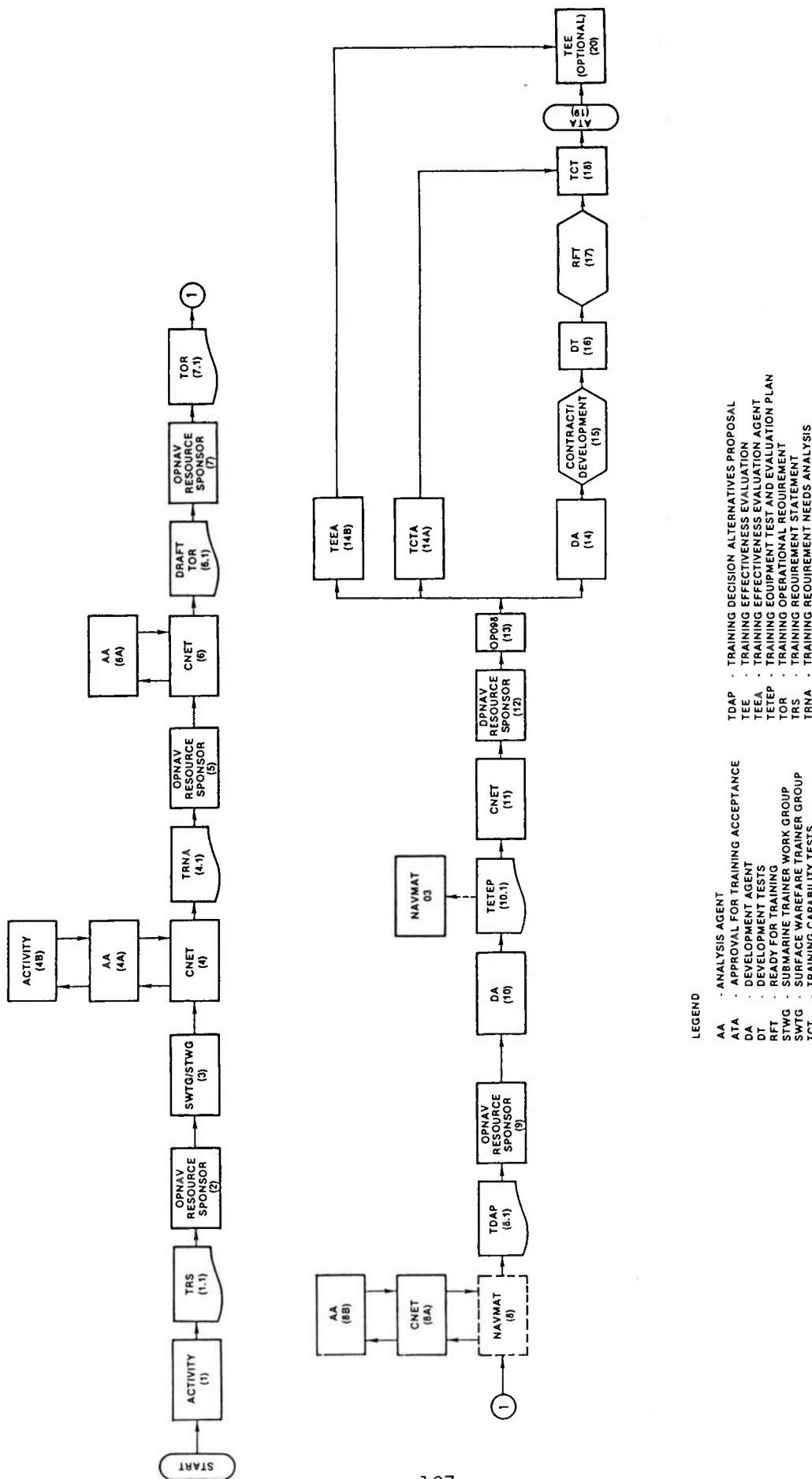


Figure A-1. RDT&E Events and Documentation Flow for First Article Training Devices. (Nutter and Terrell, 1982.)

Event 2 Resource Sponsor. OPNAV resource sponsors are the terminal points of TRS's submitted by fleet activities or Naval commands. The sponsors establish priorities for TRS's.

Event 3 SWTG and STWG. The SWTG or STWG determine the initial acceptability of the TRS for further development. Since it does not have an advisory group corresponding to the SWTG and STWG, OP01 performs the actions included in event 3 for OP01 projects [and presumably, OP05 performs them for OP05 projects.]

Event 4 Chief of Naval Education and Training (CNET). CNET tasks the analysis agent (AA), normally NTEC, to perform a preliminary front end analysis related to the needs addressed in the TRS. The AA working with the advice and input of concerned activities (event 4b), provides for the performance of the analysis and submits to CNET a Training Requirement Needs Analysis (TRNA) for review and approval.

Document 4.1 Training Requirement Needs Analysis (TRNA). The TRNA is a proposed document modelled after the intent of the Milestone 0 decision point. The TRNA serves as the baseline document for development of subsequent program documents. The primary objective of the TRNA is to provide a preliminary assessment of the training situation including: a statement of the training problem, training objectives, tentative solution (which may include a training device), and budget estimates.

Event 5 Resource Sponsor. The TRNA is submitted by CNET to the OPNAV resource sponsor. Resource sponsor approval of the TRNA signifies

establishing the training requirement and commits resources to formally develop a Training Operational Requirement (TOR). Resource sponsor criteria for approval include: validity of training requirement, perceived need for a solution, priority of the training requirement, and funding availability.

Event 6 Chief of Naval Education and Training (CNET). The resource sponsor tasks CNET to prepare a TOR. Normally, the TOR would be prepared by the AA (Event 6a) and forwarded to CNET for concurrence. The TOR is submitted in draft form to the Resource Sponsor for official issue.

Document 6.1 Training Operational Requirement (TOR). The TOR is the proposed training device version of the operational requirement (OR). The TOR not to exceed three pages, is a concise statement of training needs. It is the basic requirement document for all Navy training acquisition programs requiring research and development effort. The TOR directs the Chief of Naval Material to prepare a Training Decision Alternative Proposal (TDAP).

Event 7 Resource Sponsor. The OPNAV resource sponsor approves the TOR (Document 7.1) and issues it with a request for development of a Training Decision Alternative Proposal (TDAP).

Event 8 Chief of Naval Material (NAVMAT). The Chief of Naval Material may designate NTEC, under the command of CNET, to serve as analysis agent to plan and execute projects for developing training material. The AA prepares the TDAP for CNET concurrence and submission to the resource sponsor via the CHNAVMAT.

Document 8.1 Training Decision Alternatives Proposal (TDAP). The TDAP is the proposed training community version of the Development Proposal (DP). The TDAP subsumes the TR&A and contains updated information and more indepth analysis related to those elements which describe the alternate solutions and trade-offs designed to achieve a particular range of capabilities in response to the TOR. Cost-benefit data and technical considerations are provided to assist the resource sponsor in selecting from among the specified alternatives.

Event 9 Resource Sponsor. The OPNAV resource sponsor selects an alternative from among those described in the TDAP or returns the TDAP for additional analysis. If the TDAP is approved, the resource sponsor tasks the development agent to develop the selected alternative and submit a Training Equipment Test and Evaluation Plan (TETEP) (Document 10.1) for approval. The TETEP is analogous to the the previously employed NDCP (Navy Decision Coordinating Paper) and TEMP (Test and Evaluation Master Plan).

Event 10 Development Agent (DA). The DA usually Naval Training Equipment Center (NTEC), prepares the TETEP. The DA recommends to the Resource Sponsor, at the earliest possible date, the formation of a Fleet Project Team (FPT).

Document 10.1 Training Equipment Test and Evaluation Plan (TETEP). The TETEP is the proposed training community version of the the TEMP. The TETEP includes the information formally covered in NDCP as well as test and evaluation plans, and replaces the NDPC as the Program Initiation Document for the acquisition process. The TETEP and its two required appendices, the Training Equipment Functional Baseline (TEFB) and the Training Facilities

Requirement (TFR), basically form a contractual agreement among the development agent, the testing agents, the Naval Facilities Engineering Command, and the CNET. This relationship is approved by the resource sponsor.

Event 11 Chief of Naval Education and Training (CNET). The CNET, as training agent, specifies and approves the provisions in the TETEP which relate to training. The CNET recommends approval and forwards TETEP to the resource sponsor.

Event 12 Resource Sponsor. When the Resource Sponsor approves the TETEP, it officially authorizes the program start. Approved TETEP's are sent to CNO (OP-098, Director, Research, Development, Test and Evaluation) for promulgation.

Event 13 CNC (OP-098). OP-098 acts for OPNAV as sponsor for the RDT&E appropriation and manages the planning and reporting procedures followed during the conduct of RDT&E. OP-098 also coordinates the formulation and promulgation of RDT&E requirements, appraises the progress of RDT&E effort, and where appropriate, recommends projects for curtailment, suspension, or cancellation. Finally, OP-098, as the OPNAV focal point for TETEP, reviews them for adequacy of planned operational testing, including funding and scheduling. Promulgation of the TETEP and updated versions by OP-098 indicates acceptance of the RDT&E process to that point in the program and authorizes the continuation of development efforts.

Event 14 Development Agent (DA). The DA prepares requests for proposals (RFP) based on the TEFB (Training Equipment Functional Baseline)

[analogous to the military characteristics MC document] and supporting documents, negotiates the contract(s), monitors and coordinates contractor development progress, and conducts development tests as specified in the TETEP.

Event 15 Contract Development. This event represents that period of time required for preparation of contractual documents and the time required for the training device development and fabrication. [During this time the development agent and the fleet project team have a very important role in assuring that a suitable product is being developed.]

Event 16. Development Tests (DT). Development tests are conducted throughout the different stages of actual development of the prototype device by the DA in concert with the fleet project team. Development tests demonstrate that the engineering design meets performance, maintainability, supportability, environmental compatibility, and system safety requirements as stated in the TEFB (Training Equipment Functional Baseline). Development tests may include contractor tests and Navy acceptance tests. The final DT phase is usually on-site acceptance testing, the purpose of which is to certify that the device meets all technical requirements specified, and is ready for "Ready for Training" testing.

Event 17. Ready for Training (RFT). Ready For Training certifies that the training device, installation, logistic support, training syllabus, lesson plans and instructor training requirements as defined in the contract have been met and the device is ready for training.

Event 18 Training Capability Test (TCT). Following certification of RFT the device is submitted to a TCT by an independent agent. Independent agent is defined as a command or agency independent of the developing, procuring, and using commands.

Event 19 Approval for Training Acceptance (ATA). Devices which are certified RFT and which meet the requirements defined in the TEFB (Training Equipment Functional Baseline) are certified ATA. Once a device is certified ATA, follow-on devices may be procured throughout the training command. [Obviously, there results a great pressure to obtain prompt certification of ATA.]

Event 20 Training Effectiveness Evaluation (TEE). CNET may require a TEE. This decision must be made early in the acquisition cycle so that the DA may include planning and budgeting for the TEE in the TETEP. The TEE is performed by an independent agent who determines whether the device is effective in training students to satisfy their course objectives and in rare cases whether the training is transferrable to performance on the job.

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